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# Regioselective functionalization of unprotected *myo*-inositol by electrophilic substitution

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ABSTRACT

Unprotected *myo*-inositol was treated with various electrophiles, such as aroyl chlorides, tosyl chloride and *tert*-butyldiphenylsilyl chloride in a solution of LiCl/DMA or DMSO to afford regioselectively 1,3-di-*O*-substituted or racemic 1-*O*-substituted derivatives, depending on a quantity of reagents and reaction time. α-Unbranched alkanoic acid anhydrides in LiCl/DMA in the presence of triethylamine were suitable for acylation of *myo*-inositol, in contrast to the fact that acylation using alkanoyl chlorides in aprotic polar solvents generally does not proceed well due to decomposition of the reagents by the reaction with the solvents.



## 1. Introduction

It is generally unavoidable to use protecting groups in multistep synthesis of target organic molecules. Polyhydroxy compounds, such as carbohydrates and cyclitols have been often used as starting material for total synthesis of natural products and so on,[1] and for preparation of synthetic tools, such as chiral ligands and organocatalysts.[2] However, straightforward introduction of a desired functionality at the specified position as the first step is synthetically problematic, because they have more than one hydroxyl group with more or less similar reactivity. The polyols are generally transformed first to acetal derivatives for temporal protection.[3] Such use of temporary protecting groups increases the number of steps to reach the target molecule and decreases the overall efficiency of the synthesis. Therefore, the direct functionalization of a starting polyol is highly desirable, especially to obtain useful materials with a variety of applications. Stannylene methodology[4] and its catalytic versions[5] have been shown to be effective for regioselective substitution of unprotected glycosides. The similar borinic acid catalyzed substitution methodology was recently reported.[6] Recent approaches using chiral tertiary amines accomplished regioselective acylation of unprotected saccharides.[7,8] However, such methodologies for the selective substitution have not been applied to unprotected inositol, one of the important cyclitols. Enzymatic hexadecanoylation of *myo*-inositol (**1**) was reported briefly to yield 1-*O*-acylated product,[9] whereas enzymatic acylation has been comprehensively explored.[10]

*myo*-Inositol and *chiro*-inositol have been used as the starting materials for the synthesis of physiologically important inositol derivatives[11] as well as for the total synthesis of various natural products[12] and analogues.[13] Also they have been used as precursor for liquid crystals,[14] surfactant,[15] metal-complexing agents[16] and gelators.[17] Almost all these molecules were synthesized via inositol monoketals, diketals, or the orthoesters.[18] Common substitution reactions, such as acylation, sulfonylation, silylation of unprotected inositols could not be used synthetically, even though there are many reports on the regioselective substitution of partially protected inositols at the mesomeric 1- and/or 3-OH positions adjacent to the axial 2-OR.[18] A trial of a chemical acylation of **1** by transesterification under basic conditions afforded a mixture of all four possible monoesters in low yield.[15e] The available chemical method to introduce a substituent at 1-OH takes six steps as evident in the synthesis of racemic 1-*O*-acyl-*myo*-inositol **6**.[†] Briefly, 1,2-cyclohexylidene ketal **2** derived from **1** in two steps, was fully benzylated, hydrolyzed, acylated and then debenzylated to yield the target molecule **6** (Scheme 1).[15e] Similarly, mesomeric 1,3-di-*O*-

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[†] All compounds in the text are racemic or mesomeric. The structures portrayed correspond, for convenience, to one enantiomer, but the DL-form is implied.

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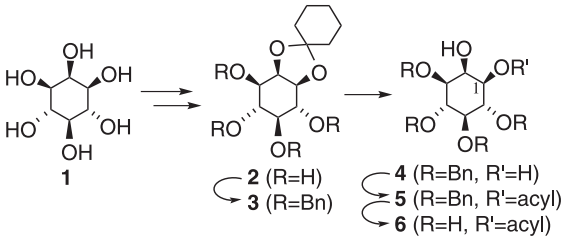
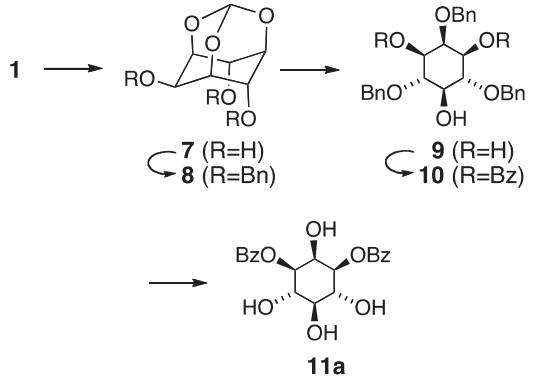



**Scheme 1.** Representative procedure for synthesis of racemic **1**-*O*-substituted *myo*-inositol.

substituted *myo*-inositol derivatives, 1,3-dibenzoate **11a** was prepared from **1** in five steps via orthoester **7** (Scheme 2).[19] The monoesters and dibenzoate were prepared as the key intermediate, respectively, to develop an inositol-based surfactant and to search the biological activity of inositol derivatives. If the mono- and disubstituted inositols can be obtained directly from **1**, a variety of functional molecules as described above can be conveniently prepared. In this context, we recently exploited the regioselective 1,3-di-*O*-substitution method giving dibenzoate **11a**, ditosylate, and so on in excellent yields.[20] The method was achieved by dissolving **1** in *N*,*N*-dimethylacetamide (DMA) containing LiCl or dimethyl sulfoxide (DMSO). We have further studied the use of dissolution methodology for the introduction of aliphatic substituents on the hydroxyls at the 1 and 3 positions, and for monosubstitution at the 1-OH. We report herein the full details of the selective disubstitution and monosubstitution of *myo*-inositol (**1**).




**Scheme 2.** Reported procedure for synthesis of 1,3-di-*O*-substituted *myo*-inositol.

## 2. Results and discussion

### 2.1. Synthesis of 1,3-di-*O*-substituted *myo*-inositol derivatives

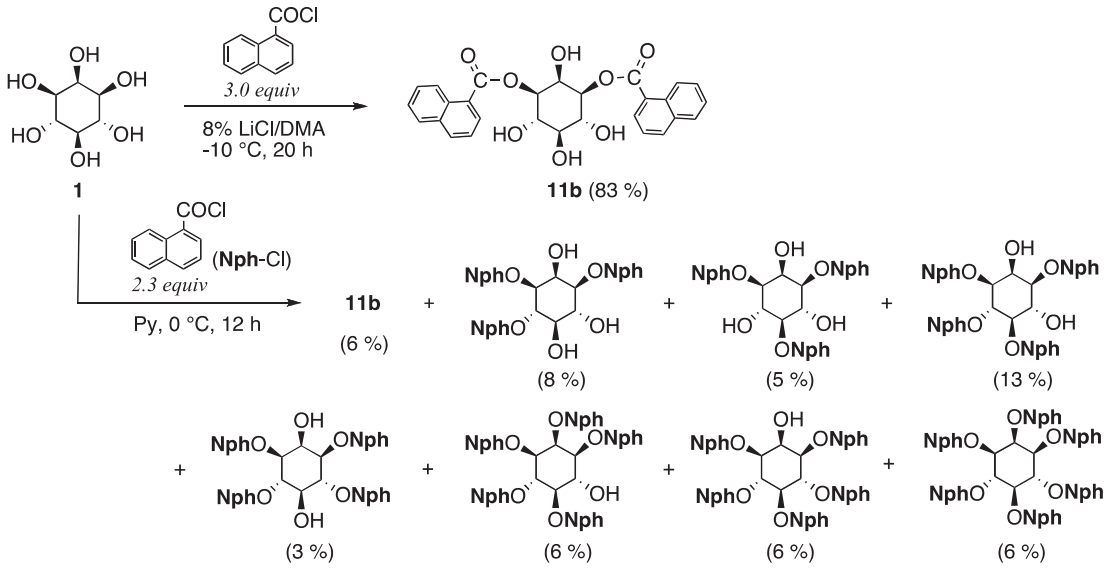
According to the conventional procedure for acylation of an alcohol, inositol **1** was treated with 2.3 M equiv of 1-naphthoyl chloride in pyridine at 0 °C for 12 h to yield surprisingly a mixture of acylated products including fully acylated product and two pentacyl derivatives (Scheme 3). The result may be explained by assuming that the low solubility of *myo*-inositol in pyridine retards the initial acylation step and increase in the number of substituents on the inositol accelerates the reaction due to increase in solubility. On the basis of this consideration, we searched for a solvent suitable for dissolving the inositol, and found DMSO and LiCl-DMA[21] to be candidates for the purpose. A DMSO solution of **1** enabled a successful isopropylidenation[22] as well as a full methylation.[23]

As expected, inositol **1** in a solution of 8% LiCl/DMA reacted smoothly in the presence of triethylamine at −10 °C with 1-naphthoyl chloride to give 1,3-di-*O*-(1-naphthoyl)-*myo*-inositol **11b** exclusively in 83% yield, while the suspension conditions described above gave only 6% of **11b**. To dissolve **1** in DMA, at least 3.4 equiv of LiCl was needed, and 8(w/v)% LiCl solution was usually employed. Aromatic acid chlorides and pivaloyl chloride with no α-proton afforded 1,3-di-*O*-substituted products in good to excellent yields (Table 1). An α-branched alkanoyl chloride, diphenylacetyl chloride was treated with **1** in the presence of excess of pyridine and a catalytic amount of DMAP instead of triethylamine to give 1,3-diacyl derivative in good yield. The 1,3-di-*O*-silylation using *tert*-butyldiphenylsilyl chloride and 1,1,3,3-tetraisopropyldisiloxanyl dichloride was accomplished well in a solution of DMSO and pyridine (5:3) in place of LiCl/DMA and triethylamine, furnishing **11f** and **12**, respectively. The latter product was smoothly formed in 88% yield, while the reaction in pyridine under suspension conditions proceeded sluggishly giving the same product in 66%.[24,25] The LiCl/DMA medium was generally better for substitution reactions than DMSO, except for silylation, mainly because the latter solvent is more nucleophilic to react predominantly with an electrophile rather than with **1**.

Disubstitution products thus obtained were often water soluble, therefore, in such cases trimethylsilylation of the products was carried out in situ after the substitution reaction followed by extraction into an organic layer. The TMS ethers **12** were transformed back without isolation to the desired products by trifluoroacetic acid catalyzed methanolysis. Since the silylation and desilylation both proceed quantitatively with simple operation, the procedure is quite convenient to separate a water soluble product from LiCl and DMA.

In the case of introduction of an alkanoyl group with the α-methylene, the acid chloride was not suitable as an electrophile under the same reaction conditions as described above. For example, when hexanoyl chloride was used in the presence of triethylamine in LiCl-DMA, the corresponding ketene dimer was formed predominantly.[26] The chloride in the presence of pyridine was consumed mainly in the Vilsmier-type reaction with DMA.[27] To avoid these undesirable reactions, we chose next a less reactive acid anhydride as an acylating agent. Thus, the reaction of hexanoic anhydride with **1** in the presence of triethylamine and catalytic amount of dibutyltin dipivalate (**15**, R′=*t*-Bu)[28] proceeded smoothly at 0 °C to give selectively 1,3-di-*O*-hexanoate in 86% yield. In a similar manner, acetic, octanoic and dodecanoic acid anhydrides acylated *myo*-inositol **1** selectively in good yields. Because of the low solubility of dodecanoic anhydride in DMA, the anhydride was treated in a mixed solvent system of DMA and $CH_2Cl_2$ (3:2). Since both dissolution in DMA and commercial availability of alkanoic anhydrides with a long chain are difficult, the corresponding long chain alkanoic acids were activated by the formation of mixed anhydrides with pivaloyl chloride, giving a result similar to that obtained in the case of the symmetric anhydride (Table 2, run 3 and 6). The tin(IV) reagent was important to accomplish the selective reaction, as its absence resulted in further acylation and reduced selectivity. When the tin diacetate (**15**, R′=Ac) instead of the dipivalate was used, the desired 1,3-dihexanoyl product **14b** was accompanied by the mixed ester, 1-*O*-acetyl-3-*O*-hexanoyl derivative.

A combination of a carboxylic anhydride and triethylamine is not a practical procedure to acylate an alcohol in good yield. Therefore, the successful acylation of **1** in DMA may be accomplished by an assistance of LiCl. The same combination of anhydride, triethylamine, and LiCl is used for *N*-acylation of 2-oxazolidinones.[29] In order to explore the role of LiCl, benzoylation of alcohols with benzoic anhydride was carried out in the presence or absence of LiCl. Promotion of the reaction by LiCl was observed especially in the case of secondary alcohol (Table 3, run 4 and 5). Replacement of LiCl with $LiClO_4$ reduced the yield similar to that obtained in the absence of an additive. These results show that the chloride anion participates in the promotion of the reaction rather than the lithium cation. A similar contribution of the chloride was reported in the decomposition of

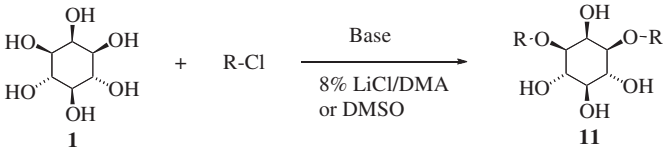


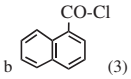
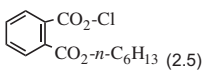

**Scheme 3.** Naphthoylation of *myo*-inositol under homogeneous and heterogeneous conditions.

carboxylic and carbonic mixed anhydrides by LiCl.[30] It is obvious, however that, since benzoyl chloride did not work for benzoylation (Table 3, run 6), the active species is not the chloride itself, which may be derivatized by decomposition of the anhydride with the chloride ion. On the other hand, it is assumed in the synthesis of *N*-acyl-2-oxazolidinone that the Li cation activates anhydride or oxazolidinone by chelation.[29a] Such a role of the Li cation may also be considerable in the present reaction. Consequently, the cooperative action of LiCl as a Lewis acid by the lithium cation and nucleophilic property by the chloride ion, is now plausible.

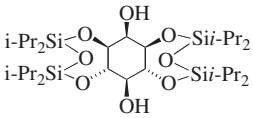
There have been so far two reports on the preparation of 1,3-symmetrically substituted *myo*-inositols. According to the literature, ditosylate[31] and dibenzoate[19] were obtained from **1** in five steps each. They are now available directly from inositol **1** without protection. Thus, the present regioselective *O*-substitution method based on a solubilization strategy opens the way to create promising materials bearing inositol with a variety of functions.

**Table 1**
Synthesis of 1,3-di-*O*-substituted *myo*-inositol **11** using various kinds of chlorides




| Run | R–Cl (equiv) | Base (equiv) | Solv.[a] | Temp | Time, h | Yield, % |
|---|---|---|---|---|---|---|
| 1 | **a** PhCO–Cl (3) | $Et_3N$ (7) | A | −10 °C | 4 | 95[b] |
| 2 | b  (3) | $Et_3N$ (7) | A | −10 °C | 20 | 83 |
| 3 | c  (2.5) | $Et_3N$ (7) | A | −10 °C | 9 | 85 |
| 4 | **d** *t*-BuCO–Cl (3) | $Et_3N$ (5) | A | 0 °C | 10 | 88[b] |
| 5 | **e** $Ph_2CHCO$–Cl (2.7) | Py (16), DMAP (cat.) | A | −10 °C | 4 | 80 |
| 6 | **f** *t*-Bu$Ph_2Si$–Cl (3) | Py (exs) | B | rt | 72 | 89 |
| 7 | **g** *p*-Me$PhSO_2$–Cl (2.4) | $Et_3N$ (5) | A | 0 °C | 24 | 87 |
| 8 | **h** $Ph_2P(O)$–Cl (3) | $Et_3N$ (7) | A | 0 °C | 20 | 86[b] |
| 9 | **i** $[i\text{-}Pr_2Si(Cl)]_2$–O (2.2) | Py (exs) | B | rt | 20 | 88[c] |

[a] A: 8% LiCl/DMA; B: DMSO/pyridine (5:3).
[b] The TMS derivative **13** was used for extraction with AcOEt.
[c] The product is the disiloxanylidene derivative **12** shown below.


**12**

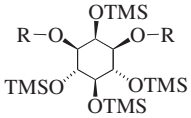
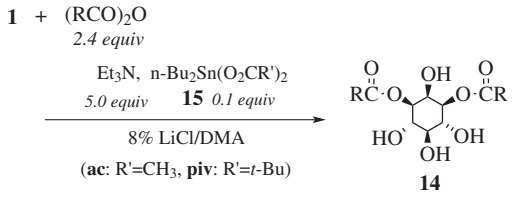

**13**

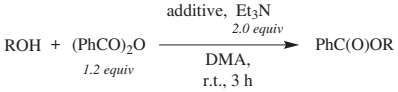
**Table 2**
Acylation of *myo*-inositol with alkanoic anhydrides




| Run | R (anhydride) | 15 | Temp | Time | Yield, % |
|---|---|---|---|---|---|
| 1 | **a** $CH_3$ | **ac** | −10 °C | 2 h | 90 |
| 2 | **b** $CH_3(CH_2)_4$ | **piv** | 0 °C | 2.5 h | 86 |
| 3 | **c** $CH_3(CH_2)_6$ | **piv** | 0 °C | 2.5 h | 87 |
| 4 | **d** $CH_3(CH_2)_{10}$ | **piv** | 0 °C | 16 h[a] | 70 |
| 5 | **e** *cis*-9-$C_{17}H_{33}$ | **piv** | 0 °C | 12 h | 85 |
| 6 | **c** $CH_3(CH_2)_6$[b] | **piv** | 0 °C | 5.5 h | 76 |

[a] LiCl-DMA/$CH_2Cl_2$ (3:2) used in place of LiCl-DMA.
[b] The mixed anhydride with pivalic acid used.

**Table 3**
Effect of LiCl on the reaction of benzoic anhydride




| Run | ROH | Additive (equiv) | Yield, % |
|---|---|---|---|
| 1 | $Ph(CH_2)_3OH$ | — | 54 |
| 2 | $Ph(CH_2)_3OH$ | $LiClO_4$ (1.9) | 61 |
| 3 | $Ph(CH_2)_3OH$ | LiCl (2.6) | 81 |
| 4 | $PhCH(CH_3)OH$ | — | 6 |
| 5 | $PhCH(CH_3)OH$ | LiCl (2.3) | 50 |
| 6[a] | $PhCH(CH_3)OH$ | — | 6 |

[a] PhCOCl used in place of the anhydride.

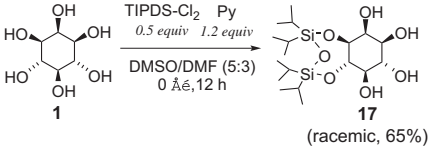
## 2.2. Synthesis of 1-*O*-substituted DL-*myo*-inositol derivatives

We next tried a selective monosubstitution at the one of two chemically equivalent 1- and 3-OH in **1**. After many trials, changing the reaction time and reducing the quantity of electrophile resulted in the formation of regioselectively monosubstituted derivative **16** (racemic mixture) as a major product accompanied by traces of 1,3-disubstitution product **11** (Table 4). Both products were isolated via the trimethylsilylation and desilylation procedure. Exceptionally, diastereomeric 1-*O*-(−)-menthyloxycarbonyl-*myo*-inositol (**16f**) was extracted with AcOEt without the silylation and isolated by silica gel chromatography.

Monobenzoate **16a** was reported to be obtained in 43% yield accompanied with 17% of dibenzoate by the successive three-step procedure involving full diethylborylation, partial stannylidenation and then benzoylation.[32] Monotosylate **16h** was prepared by multi-step procedures (four[33] and six[34] steps, respectively), in which both the tosylations of partially protected inositols took long time and needed even application of heat in one case (5 °C, 24 h then rt, 6 days for the former and rt, 4 days then 80 °C, 3 h for the latter).

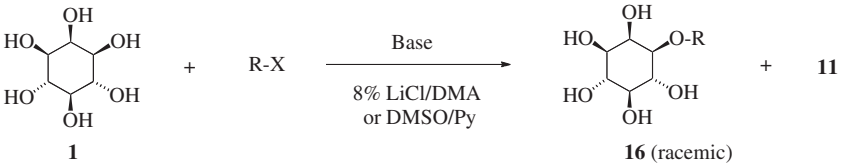
The diastereomeric carbonates **16f** were derived by the boron–tin methodology described above and optically resolved to two stereoisomers by crystallization.[35] One of them was used as the optically active intermediate to synthesize inositol 1,4,5-trisphosphate[35] and glycosyl inositols.[36] Thus, the chiral carbonate is one of two generally applicable chiral inositol intermediates including camphor ketal.[37] Inositol 1-fatty acid esters are being explored as surfactants.[15a,e] We have now synthesized these useful inositol derivatives directly in one-step from *myo*-inositol **1** without protection.

The 1,3-disiloxanylidene protecting group is useful for the partial protection of vicinal diol in polyols.[38] It has been well employed for the synthesis of inositol derivatives[24] as biologically active compounds[22b,39] and gelators.[17a,b] Considering these reports, 1,6-*O*-disiloxanylidene inositol **17** may be recognized as a widely applicable synthetic intermediate. Thus, the reaction of **1** with half molar equivalent of TIPDS-$Cl_2$ in the presence of pyridine in DMSO/DMF proceeded smoothly to give **17** in 65% yield (Scheme 4).




**Scheme 4.** Selective mono(disiloxanylation) of *myo*-inositol.

**Table 4**
Synthesis of **1**-*O*-mono-substituted DL-*myo*-inositols




| Run | R–X (equiv) | | Base (equiv) | Solv.[a] | Temp | Time | Yield, % | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | **16** | **11** |
| 1 | **a** PhCO–Cl | (1.5) | $Et_3N$ (4) | A | −23 °C | 2 h | 78[b] | 13 |
| 2 | **b** *p*-(*n*-$C_6H_{13}O$)PhC(O)–Cl | (1.3) | $Et_3N$ (5) | A | 0 °C | 24 h | 63 | 20 |
| 3 | **c** *t*-BuCO–Cl | (1.5) | $Et_3N$ (3) | A | −10 °C | 2.5 h | 72 | 21 |
| 4 | **d** [*n*-$C_5H_{11}C(O)]_2O$ | (1.2) | $Et_3N$ (3) | A | −15 °C | 70 min | 61 | 12 |
| 5 | **e** *n*-$C_7H_{15}C(O)O(O)Ct$-Bu | (1.2)[b] | $Et_3N$ (3) | A | −15 °C | 1.5 h | 55 | 7 |
| 6 | **f** (−)-Menthyl-OC(O)–Cl | (1.5) | Py (16) | A | 0 °C then rt | 10 min then 14 h | 78 | — |
| 7 | **g** *t*-$BuPh_2Si$–Cl | (0.8) | Py (exs), DMAP (cat.) | B | rt | 20 h | 51 | 13 |
| 8 | **h** *p*-$MePhS(O)_2$–Cl | (1.8) | $Et_3N$ (5) | A | 0 °C | 10 | 59 | 8 |
| 9 | **i** *p*-$C_{12}H_{25}PhS(O)_2$–Cl | (1.5) | $Et_3N$ (5) | A | rt | 24 | 66 | 16 |
| 10 | **j** (*n*-$BuO)_2P(O)$–Cl | (1.3) | $Et_3N$ (1.5) | A | 0 °C then rt | 5 min then 16 h | 56 | — |

[a] A: 8% LiCl/DMA; B: DMSO/Pyridine (5:3).
[b] Prepared prior to use and used without purification.

## 3. Conclusion

A direct functionalization of 1- and 3-OH in *myo*-inositol **1** by acyl, sulfonyl, phosphinyl and silyl groups has now been achieved efficiently by conducting the reaction in a solution in DMA containing LiCl and DMSO. The similar procedure using a limited amount of electrophiles yielded 1-*O*-mono-substituted derivatives predominantly. These inositol derivatives themselves may be used as candidates of functional materials, such as surfactants.[15] They may be also useful intermediates for synthesis of a variety of compounds including natural and analogous products, monomers for polymer synthesis, and so on.

## 4. Experimental

### 4.1. General method

*myo*-Inositol (**1**, Tsuno Food CO Ltd) was dried by heating at 200 °C for 12 h under reduced pressure (0.5 mmHg). Anhydrous DMA and DMSO were obtained by treating with powdered BaO and $CaH_2$ overnight, respectively, and subsequent distillation (about 70 °C/25 mmHg and about 40 °C/1 mmHg). LiCl is so hygroscopic that it was weighed quickly in a reaction vessel and dried by application of heat at about 400 °C under reduced pressure (0.5 mmHg) for a few min. Its DMA solution was first prepared by addition of **1** and the solvent, and then necessary reagents for the reaction were added. TLC Silica gel 60 $F_{254}$ (Merck Ltd. Japan) was used for analytical TLC. Flash column chromatography was performed using silica gel (Fuji Silysia Chemical Ltd. BW-300).

### 4.2. Representative procedures for synthesis of 1,3-di-*O*-substituted *myo*-inositol

*4.2.1. Synthesis of 1,3-di-O-benzoyl-myo-inositol (**11a**) via the trimethylsilylation procedure.* To a reaction flask containing LiCl (400 mg, 9.44 mmol) was added *myo*-inositol (100 mg, 0.55 mmol) and DMA (5 mL), and the mixture was heated at about 120 °C until the mixture became a clear solution (about 3 min). After addition of $Et_3N$ (391 mg, 3.89 mmol), the resulting solution was kept at −10 °C, and then benzoyl chloride (234 mg, 1.67 mmol) was added. The mixture was stirred at the same temperature for 4 h, and chlorotrimethylsilane (1 mL, 7.82 mmol) and pyridine (2 mL) were carefully added. The mixture was stirred at 0 °C for 5 h, and diluted with $H_2O$ and AcOEt. After partition to two layers, the aqueous layer was extracted with AcOEt (×3). The combined organic layer was washed successively with $H_2O$ (×2), 0.5 N HCl solution, $H_2O$, saturated $NaHCO_3$ solution, $H_2O$, and then brine, dried over $Na_2SO_4$, filtered and evaporated. The residue was dissolved in a small volume of $CHCl_3$ (1 mL), and MeOH (5 mL) and $CF_3CO_2H$ (74 mg, 0.64 mmol) were added. The solution was stirred for 4 h at rt, and all the volatile materials were distilled off under reduced pressure (1.0 mmHg). The residue was subjected to a column chromatography on silica gel (MeOH/$CHCl_3$ 1:10) to give crystalline 1,3-di-*O*-benzoate (205 mg, 95% yield). $R_f$ 0.5 (MeOH/$CHCl_3$ 1:4); mp 174.5–175.0 °C (AcOEt/Hexane); $^1$H NMR (400 MHz, $CD_3OD$) $\delta$ 3.44 (1H, t, $J$=9.8 Hz), 4.08 (2H, t, $J$=9.8 Hz), 4.43 (1H, t, $J$=2.6 Hz), 5.01 (2H, dd, $J$=9.8 and 2.6 Hz), 7.47 (4H, t, $J$=8.0 Hz), 7.60 (2H, t, $J$=8.0 Hz), 8.00 (4H, d, $J$=8.0 Hz); $^{13}$C NMR (100 MHz, $CD_3OD$) $\delta$ 69.29, 71.89, 75.90, 76.52, 129.42 (4C), 130.88 (4C), 131.50 (2C), 134.26 (2C), 167.69 (2C); IR (KBr) 3600, 3512 (broad), 1713 cm$^{-1}$; LRMS (FAB+, *m*-nitrobenzyl alcohol) *m*/*z*: 389 [M+1]; Anal. Calcd for $C_{20}H_{20}O_8 \cdot 1/2H_2O$: C, 60.45; H, 5.33. Found: C, 60.09; H, 5.13.

*4.2.2. Synthesis of 1,3-di-O-(1-naphthoyl)-myo-inositol (**11b**).* To a reaction flask containing LiCl (400 mg, 9.44 mmol) was added inositol (100 mg, 0.55 mmol) and DMA (5 mL), and the mixture was heated at about 120 °C until the mixture became a clear solution (about 3 min). After addition of $Et_3N$ (391 mg, 3.89 mmol), the resulting solution was kept at −10 °C, and then 1-naphthoyl chloride (317 mg, 1.67 mmol) was added. The mixture was stirred at the same temperature for 20 h. $H_2O$ (about 0.1 mL) was added and the mixture was stirred for 10 min, partitioned to AcOEt and $H_2O$ layers. The aqueous solution was extracted three times with AcOEt. The combined extract was washed with $H_2O$ (×3) and brine, dried over $Na_2SO_4$, filtered, and then evaporated. The residue was recrystallized from AcOEt/hexane to give crystals **11b** (193 mg, 71%). The remaining dinaphthoate (32 mg, 12%) was isolated from the mother liquor by a flash column chromatography on silica gel (MeOH/$CHCl_3$ 1:14), $R_f$ 0.4 (MeOH/$CHCl_3$ 1:10); mp 195.5–196.0 °C (AcOEt/Hexane); $^1$H NMR (270 MHz, $CD_3OD$) $\delta$ 3.61 (1H, t, $J$=9.6 Hz), 4.23 (2H, t, $J$=9.6 Hz), 4.73 (1H, t, $J$=2.4 Hz), 5.26 (2H, dd, $J$=9.6 and 2.4 Hz), 7.61 (6H, complex), 7.96 (2H, d, $J$=8.0 Hz), 8.11 (2H, d, $J$=8.4 Hz), 8.41 (2H, d, $J$=7.2 Hz), 9.00 (2H, d, $J$=8.4 Hz); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$ 69.58, 72.26 (2C), 76.30 (2C) 77.04, 125.9, 127.2, 127.6, 128.8, 128.9, 129.9, 131.9, 132.9, 134.8, 135.5 (10C), 169.0; IR (KBr) 3461 (broad), 3360 (shoulder), 1715, 1692 cm$^{-1}$; LRMS (FAB+, *m*-nitrobenzyl alcohol) *m*/*z*: 689 [M+1]$^+$; Anal. Calcd for $C_{28}H_{24}O_8$: C, 68.85; H, 4.95. Found: C, 68.56; H, 4.91.

*4.2.3. Synthesis of 1,3-di-O-hexanoyl-myo-inositol (**14b**) in the presence of dibutyltin dipivalate.* To a DMA (1 mL) solution of **1** (100 mg, 0.55 mmol) and LiCl (80 mg, 1.89 mmol) were added triethylamine (281 mg, 2.78 mmol) and dibutyltin dipivalate (24 mg, 0.05 mmol), the mixture was cooled at 0 °C, and then hexanoic anhydride (173 mg, 1.33 mmol) was added slowly. The mixture was stirred for 2.5 h, TMSCl (1 mL, 7.82 mmol) and pyridine (2 mL) were added at the same temperature, then the reaction was continued at rt for 2 h. The resulting mixture was cooled at 0 °C, a few drops of water was added, and stirring was continued for 10 min. After addition of ethyl acetate, the organic layer was washed sequentially with $H_2O$ (×2), 1 N HCl, $H_2O$, saturated aqueous $NaHCO_3$, $H_2O$, and brine, tried over $MgSO_4$, and concentrated. The residue in chloroform (2 mL) and methanol (4 mL) was mixed with two drops of trifluoroacetic acid, the mixture was stirred for 2 h at rt, and then volatile materials were distilled off under reduced pressure. The residue was purified by a flash column chromatography (MeOH/$CHCl_3$ 1:15) to furnish **14b** (180 mg, 86%). $R_f$ 0.4 (MeOH/$CHCl_3$ 1:10); mp 145–147 °C (AcOEt/Hexane); $^1$H NMR (270 MHz, $CDCl_3$) $\delta$ 0.90 (6H, t, $J$=6.6 Hz), 1.28–1.34 (8H, complex), 1.65 (4H, quint, $J$=7.3 Hz), 2.37 (2H, dt, $J$=14.6 and 7.3 Hz) 2.43 (2H, dt, $J$=14.6 and 7.3 Hz), 3.51 (1H, t, $J$=9.5 Hz), 3.98 (2H, t, $J$=9.5 Hz), 4.23 (1H, t, $J$=2.4 Hz), 4.87 (2H, dd, $J$=9.5 and 2.4 Hz); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$ 13.89 (2C), 22.31 (2C), 24.49 (2C), 31.24 (2C), 34.06 (2C), 69.23, 70.52 (2C), 72.79 (2C), 74.77, 173.54 (2C); IR (KBr) 3503 (sharp), 3312 (broad), 1737, 1720 cm$^{-1}$; Anal. Calcd for $C_{18}H_{32}O_8$: C, 57.43; H, 8.57. Found: C, 57.21; H, 8.85.

*4.2.4. Synthesis of 1,3-di-O-octanoyl-myo-inositol (**14c**) using the mixed anhydride.* To a solution of octanoic acid (216 mg, 1.50 mmol) and triethylamine (319 mg, 3.15 mmol) in $CH_2Cl_2$ (3 mL) was added pivaloyl chloride (233 mg, 1.80 mmol) at 0 °C, and the mixture was stirred for 2 h then evaporated to dryness. The residue was dissolved in DMA (1 mL), and a solution of **1** (100 mg, 0.55 mmol) and LiCl (80 mg, 1.89 mmol) in DMA (1 mL), DMA (0.5 mL) washing, dibutyltin dipivalate (24 mg, 0.05 mmol) and then triethylamine (281 mg, 2.78 mmol) were successively added at 0 °C. The resulting solution was stirred for 5.5 h at the same temperature, ethyl acetate and water were added. The aqueous solution was extracted three times with AcOEt, the combined extracts were successively washed with water (×3), saturated aq $NaHCO_3$, water and brine, dried ($Na_2SO_4$), evaporated. Chromatographic isolation ($SiO_2$, MeOH/$CHCl_3$ 1:15) from the residue gave **14c** (183 mg, 76%). $R_f$ 0. 4 (MeOH/$CHCl_3$ 1:10); $^1$H NMR (270 MHz, $CDCl_3$) $\delta$ 0.88 (6H, t, $J$=5.4 Hz), 1.28 (16H, broad), 1.63 (4H,

br quint, $J$=8.1 Hz), 2.36 (2H, dt, $J$=10.8 and 8.1 Hz) 2.36 (2H, dt, $J$=10.8 and 8.1 Hz), 3.52 (1H, t, $J$=10.8 Hz), 3.97 (2H, t, $J$=10.8 Hz), 4.20 (1H, br t, $J$=2.2 Hz), 4.88 (2H, dd, $J$=9.2 and 2.2 Hz); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$ 13.89 (2C), 22.31 (2C), 24.49 (2C), 31.24 (2C), 34.06 (2C), 69.23, 70.52 (2C), 72.79 (2C), 74.77, 173.54 (2C); IR (KBr) 3600 (sharp), 3503, 3350 (broad), 1737, 1720 cm$^{-1}$; HRMS (FAB+, *m*-nitrobenzyl alcohol) calcd for $C_{22}H_{41}O_8$ [M+H] 433.2801, found 433.2794.

### 4.3. Synthesis of 1,6:3,4-bis-*O*-(tetraisopropyldisiloxane-1,3-diyl)-*myo*-inositol (12)

To a solution of **1** (200 mg, 1.11 mmol) in DMSO (5 mL) was added pyridine (3 mL) and TIPDS-$Cl_2$ (771 mg, 2.44 mmol), and the mixture was stirred for 20 h at rt. After treatment with water (100 μL) at 0 °C for 10 min, the mixture was partitioned into water and AcOEt layers, the latter of which was washed with water, saturated aq $KHSO_4$, water, saturated aq $NaHCO_3$, water, and brine, and dried ($Na_2SO_4$) and evaporated. The residue was recrystallized from $CH_3CN$ and water to give the product (650 mg, 88%). $R_f$ 0.5 (AcOEt/hexane 1:10); mp 203–204 °C ($CH_3CN/H_2O$); $^1$H NMR (300 MHz, $CDCl_3$) $\delta$ 1.04–1.10 (56H, complex), 2.48 (1H, s, OH), 2.62 (1H, s, OH), 3.38 (1H, t, $J$=9.0 Hz), 3.69 (2H, dd, $J$=9.0 and 3.0 Hz), 4.00 (2H, t, $J$=9.0 Hz), 4.04 (1H, t, $J$=3.0 Hz); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$ 12.07, 12.14, 12.71, 12.84 (8C), 17.17, 17.27, 17.44 (8C), 73.73, 75.08 (2C), 75.15, 75.57 (2C); IR (KBr) 3550, 3482 cm$^{-1}$; LRMS (FAB+, *m*-nitrobenzyl alcohol) $m/z$ 665 [M+H]$^+$; Anal. Calcd for $C_{30}H_{64}O_7Si_4$ (%): C, 54.17; H, 9.70. Found: C, 54.13; H, 9.42.

### 4.4. Representative procedure for synthesis of 1-*O*-substituted DL-*myo*-inositol: synthesis of DL-1-*O*-benzoyl-*myo*-inositol (16a)

To a solution of **1** (96 mg, 0.54 mmol), LiCl (400 mg, 9.44 mmol) and triethylamine (225 mg, 2.22 mmol) in DMA (5 mL) cooled at −23 °C was slowly added benzoyl chloride (117 mg, 0.83 mmol), and the mixture was stirred for 2 h at the same temperature and then methanol was added. After 10 min, TMSCl (2 mL) and pyridine (4 mL) were added, the mixture was stirred for 3 h at rt, cooled to 0 °C, and then $H_2O$ (0.1 mL) was added. After being stirred for 10 min, the solution was partitioned to AcOEt and $H_2O$ layers. The organic solution was washed with $H_2O$ (×3), 0.5 N HCl solution, $H_2O$, saturated $NaHCO_3$ solution, $H_2O$, and then brine, dried ($MgSO_4$), filtered and then evaporated. The residue was dissolved in $CHCl_3$ (1 mL) and MeOH (2 mL), and $CF_3CO_2H$ (one drop) were added. The solution was stirred for 2 h at rt, and all the volatile materials were distilled off under reduced pressure (1.0 mmHg). The residue was subjected to a column chromatography on silica gel (MeOH/$CHCl_3$ 1:4) to give crystalline 1-*O*-benzoate **16a** (120 mg, 78%) and **11a** (29 mg, 13%). $R_f$ 0.3 (MeOH/$CHCl_3$ 1:4); mp 194–195 °C (MeOH/hexane);[40] $^1$H NMR (270 MHz, DMSO-$d_6$+$D_2O$) $\delta$ 3.07 (1H, t, $J$=9.7 Hz), 3.30 (1H, t, $J$=9.7 Hz), 3.42 (1H, t, $J$=9.7 Hz), 3.94 (1H, t, $J$=9.7 Hz), 3.94 (1H, br), 4.65 (1H, dd, $J$=9.7 and 2.4 Hz), 7.49 (2H, t, $J$=7.4 Hz), 7.62 (1H, t, $J$=6.2 Hz), 7.99 (2H, d, $J$=8.4 Hz); $^{13}$C NMR (100 MHz, $D_2O$) $\delta$ 69.93, 70.44, 70.75, 72.21, 74.10, 74.44, 128.74 (2C), 128.94 (2C), 129.64, 134.05, 167.81; IR (KBr) 3500 (sharp), 3425 (broad), 3330 (broad), 3240 (broad), 1705, 1688 cm$^{-1}$; LRMS (FAB+, *m*-nitrobenzyl alcohol) $m/z$ 285 [M+1]; Anal. Calcd for $C_{13}H_{16}O_7$: C, 54.66; H, 5.60. Found: C, 54.93; H, 5.67.

### 4.5. Synthesis of DL-1,6-*O*-(tetraisopropyldisiloxane-1,3-diyl)-*myo*-inositol (17)

To a solution of *myo*-inositol (400 mg, 2.22 mmol) in DMSO (10 mL) prepared by heating was added DMF (6 mL) and pyridine (211 mg, 2.66 mmol), and the solution was cooled at 0 °C. 1,3-Dichloro-1,1,3,3-tetraisopropyldisiloxane (350 mg, 1.11 mmol) was added and the mixture was stirred at the same temperature for 12 h, treated with $H_2O$ (100 mL) for 10 min. After addition of AcOEt, the organic layer was washed with $H_2O$, saturated aq $KHSO_4$, $H_2O$, saturated aq $NaHCO_3$, $H_2O$ and brine, dried ($MgSO_4$), evaporated. Chromatographic isolation ($SiO_2$, MeOH/AcOEt 1:20) gave **17** (1.52 g, 65% yield). $R_f$ 0.5 (MeOH/AcOEt 1:20); mp 124.0–125.5 °C (lit.[41] mp 118–121 °C); LRMS (FAB+, *m*-nitrobenzyl alcohol) $m/z$: 423 [M+1].

### 4.6. Characterization data

*4.6.1. 1,3-Di-O-(2-hexyloxycarbonyl)benzoyl-myo-inositol (**11c**).* $R_f$ 0.5 (MeOH/$CHCl_3$ 1:10); $^1$H NMR (400 MHz, $CD_3OD$) $\delta$ 0.75 (6H, t, $J$=13.2 Hz), around 1.19 (16H, complex), 1.28 (4H, complex), 3.50 (1H, t, $J$=9.6 Hz), 4.00 (2H, t, $J$=9.6 Hz), 4.59 (1H, t, $J$=2.4 Hz), 4.96 (2H, dd, $J$=9.6 and 2.4 Hz), 7.39 (4H, complex), 7.65 (4H, complex); HRMS (FAB+, *m*-nitrobenzyl alcohol) calcd for $C_{34}H_{45}O_{12}$ [M+H] 645.2912, found 645.2970; Anal. Calcd for $C_{34}H_{48}O_{12}$: C, 63.34; H, 6.88, Found: C, 63.09; H, 6.33.

*4.6.2. 1,3-Di-O-pivaloyl-myo-inositol (**11d**).* $R_f$ 0.5 (MeOH/$CHCl_3$ 1:5); mp 166–167 °C; $^1$H NMR (400 MHz, $CD_3OD$) $\delta$ 1.25 (18H, s), 3.31 (1H, t, $J$=9.8 Hz), 3.87 (2H, t, $J$=9.8 Hz), 4.10 (1H, t, $J$=2.8 Hz), 4.66 (2H, dd, $J$=9.8 and 2.8 Hz); $^{13}$C NMR (100 MHz, $CD_3OD$) $\delta$ 26.21 (6C), 38.55 (2C), 67.58, 70.34 (2C), 73.53 (2C), 75.24, 178.3 (2C); IR (KBr) 3518 (broad), 3380 (broad), 1716 cm$^{-1}$; Anal. Calcd for $C_{16}H_{28}O_8 \cdot 1/2H_2O$: C, 53.77; H, 8.18. Found: C, 53.60; H, 7.89.

*4.6.3. 1,3-Di-O-diphenylacetyl-myo-inositol (**11e**).* $R_f$ 0.6 (AcOEt/Hex 1:1); mp 149 °C (AcOEt/hexane); $^1$H NMR (400 MHz, $CD_3OD/CDCl_3$ 1:2) $\delta$ 3.32 (1H, t, $J$=9.7 Hz), 3.86 (2H, t, $J$=9.7 Hz), 4.14 (1H, t, $J$=2.6 Hz), 4.85 (2H, dd, $J$=9.7 and 2.6 Hz), 5.17 (2H, s), 7.23–7.33 (20H, complex); $^{13}$C NMR (100 MHz, $CD_3OD/CDCl_3$ 1:2) $\delta$ 56.31 (2C), 67.64, 69.83 (2C), 73.72 (2C), 74.54, 126.71 (2C), 126.82 (2C), 127.98 (4C), 128.09 (4C), 128.14 (4C), 128.22 (4C), 138.18, 138.23, 172.07 (2C); IR (KBr) 3590 (sharp), 3476 (broad), 3350 (broad), 1725 cm$^{-1}$; Anal. Calcd for $C_{34}H_{32}O_8 \cdot 1/2H_2O$: C, 70.41; H, 5.68. Found: C, 70.35; H, 5.89.

*4.6.4. 1,3-Di-O-tert-butyldiphenylsilyl-myo-inositol (**11f**).* $R_f$ 0.5 (MeOH/AcOEt 1:20); mp 81 °C; $^1$H NMR (270 MHz, $CDCl_3$) $\delta$ 1.02 (18H, s), 2.17 (1H, s), 2.36 (1H, s), 2.55 (1H, s), 3.03 (1H, t, $J$=9.3 Hz), 3.21 (2H, dd, $J$=9.3 and 2.7 Hz), 3.51 (1H, t, $J$=2.7 Hz), 3.91 (2H, t, $J$=9.3 Hz), 7.27 (8H, t, $J$=8.4 Hz), 7.39 (4H, m), 7.56 (8H, m); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$ 19.27 (2C), 26.94 (6C), 72.29, 72.81 (2C), 73.53, 73.99 (2C), 127.7, 129.9, 133.0, 135.7 (24C); IR (KBr) 3575 (sharp), 3422 (broad) cm$^{-1}$; Anal. Calcd for $C_{38}H_{48}O_6Si_2$: C, 69.47; H, 7.36. Found: C, 69.29; H, 7.34.

*4.6.5. 1,3-Di-O-p-toluenesulfonyl-myo-inositol (**11g**).* $R_f$ 0.5 (AcOEt); mp 244–245 °C (*n*-$C_3H_7OH$) {lit.[31] mp 233–234 °C (EtOH)}; $^1$H NMR (270 MHz, $CD_3OD$) $\delta$ 2.59 (6H, s), 3.23 (1H, t, $J$=9.7 Hz), 3.87 (2H, t, $J$=9.7 Hz), 4.22 (1H, t, $J$=2.6 Hz), 4.35 (2H, dd, $J$=9.7 and 2.6 Hz), 7.55 (4H, d, $J$=8.4 Hz), 7.96 (4H, d, $J$=8.4 Hz); $^{13}$C NMR (100 MHz, $CD_3OD$) $\delta$ 20.25 (2C), 68.86, 69.81 (2C), 73.80, 81.04 (2C), 127.9, 129.5, 133.8, 145.0 (12C); IR (KBr) 3422 (broad), 1354, 1176 cm$^{-1}$; Anal. Calcd for $C_{20}H_{24}O_{10}S_2$: C, 49.17; H, 4.95. Found: C, 49.09; H, 4.95.

*4.6.6. 1,3-Di-O-diphenylphosphinyl-myo-inositol (**11h**).* $R_f$ 0.4 (MeOH/$CHCl_3$ 1:3); mp 173–174 °C (benzene); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$ 3.16 (1H, t, $J$=9.2 Hz), 3.93 (2H, ddd, $J$=9.2, 7.3 and 2.6 Hz), 4.06 (2H, t, $J$=9.2 Hz), 4.40 (1H, t, $J$=2.6 Hz), 7.39 (12H, complex), 7.81 (8H, m); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$ 70.84, 70.95, 70.99, 74.05, 76.93, 77.22, 128.4, 128.6, 129.4, 130.3, 130.8, 131.6, 131.7, 132.0, 132.1, 132.2, 132.3; $^{31}$P NMR (162 MHz, $CDCl_3$) $\delta$ 34.43; IR (KBr) 3386

(broad) $cm^{-1}$; HRMS (FAB+, *m*-nitrobenzyl alcohol), calcd for $C_{30}H_{31}O_8P_2$ [M+H] 581.1494, found, 581.1476.

*4.6.7. 1,3-Di-O-acetyl-myo-inositol (**14a**).* $R_f$ 0.4 (MeOH/$CHCl_3$ 1:3); mp 173–174 °C (benzene/AcOEt); $^1H$ NMR (270 MHz, $D_2O$) $\delta$ 2.20 (6H, s, $CH_3$), 3.50 (1H, t, *J*=9.6 Hz), 3.90 (2H, t, *J*=9.6 Hz), 4.29 (1H, t, *J*=2.8 Hz), 4.88 (2H, dd, *J*=9.6 and 2.8 Hz); $^{13}C$ NMR (100 MHz, $D_2O$/$CD_3OD$) $\delta$ 21.52 (2C), 68.68, 71.26 (2C), 71.41 (2C), 74.85, 174.3; Calcd for $C_{10}H_{16}O_8$: C, 45.46; H, 6.10. Found: C, 45.26; H, 6.11.

*4.6.8. 1,3-Di-O-dodecanoyl-myo-inositol (**14d**).* $R_f$ 0.4 (MeOH/$CHCl_3$ 1:10); mp 126–128 °C (hexane/AcOEt); $^1H$ NMR (270 MHz, $CDCl_3$) $\delta$ 0.88 (6H, t, *J*=5.4 Hz), 1.26 (32H, broad), 1.64 (4H, br quint, *J*=8.1 Hz), 2.37 (2H, dt, *J*=10.8 and 8.1 Hz) 2.43 (2H, dt, *J*=10.8 and 8.1 Hz), 3.50 (1H, t, *J*=10.8 Hz), 3.98 (2H, t, *J*=10.8 Hz), 4.23 (1H, br t, *J*=2.2 Hz), 4.87 (2H, dd, *J*=10.8 and 2.2 Hz); $^{13}C$ NMR (100 MHz, $CDCl_3$) $\delta$ 14.10 (2C), 22.68 (2C), 24.88 (2C), 29.20 (2C), 29.37 (2C), 29.39 (2C), 29.57 (2C), 29.66 (2C), 29.69 (2C), 31.92 (2C), 34.15 (2C), 69.23, 70.55 (2C), 72.78 (2C), 74.80, 173.47 (2C); IR (KBr) 3595 (sharp), 3504 (sharp), 3378 (broad), 3275 (shoulder), 1742, 1720 $cm^{-1}$; HRMS (FAB+, *m*-nitrobenzyl alcohol) calcd for $C_{30}H_{57}O_8$ [M+H] 545.4053, found 545.4047.

*4.6.9. 1,3-Di-O-(cis-9-octadecenoyl)-myo-inositol (**14e**).* $R_f$ 0.5 (MeOH/$CHCl_3$, 1:10); $^1H$ NMR (400 MHz, $CDCl_3$) $\delta$ 0.89 (6H, t, *J*=8.0 Hz), 1.27–1.30 (40H, complex), 1.62 (4H, br quint, *J*=8.0 Hz), 2.00, 2.01 (4H×2, dt, *J*=12.0 and 8.0 Hz) 2.36 (2H, dt, *J*=10.8 and 8.1 Hz), 2.42 (2H, dt, *J*=14.6 and 8.0 Hz), 2.69 (1H, br s, OH), 3.53 (1H, t, *J*=10.0 Hz), 3.94 (2H, t, *J*=10.0 Hz), 4.17 (1H, br t), 4.89 (2H, dd, *J*=10.0 and 1.2 Hz), 5.09 (1H, br s, OH), 5.34 (4H, m); $^{13}C$ NMR (100 MHz, $CDCl_3$) $\delta$ 14.09 (2C), 22.66 (2C), 24.85 (2C), 27.21 and 27.22 (4C), 29.17 (2C), 29.23 (2C), 29.30 (2C), 29.32 (4C), 29.53 (2C), 29.76 (2C), 29.78 (2C), 31.89 (2C), 34.12 (2C), 69.26, 70.54 (2C), 72.72 (2C), 74.76, 129.64 and 129.96 (4C), 173.43 (2C); IR (KBr) 3598 (sharp), 3504 (sharp), 3366 (broad), 1740, 1723 $cm^{-1}$; HRMS (FAB+, *m*-nitrobenzyl alcohol) calcd for $C_{42}H_{77}O_8$ [M+H] 709.5618, found 709.5626.

*4.6.10. DL-1-O-p-Hexyloxybenzoyl-myo-inositol (**16b**).* $R_f$ 0.3 (MeOH/$CHCl_3$ 1:5); mp 183–184 °C (MeOH); $^1H$ NMR (270 MHz, $CD_3OD$) $\delta$ 0.83 (3H, t, *J*=6.8 Hz), 1.23 (4H, complex), 1.39 (2H, m), 1.70 (2H, quint, *J*=6.8 Hz), 3.19 (1H, t, *J*=9.2 Hz), 3.36 (1H, dd, *J*=9.2 and 2.8 Hz), 3.40 (1H, t, *J*=9.2 Hz), 3.88 (1H, t, *J*=9.2 Hz), 3.94 (2H, t, *J*=6.8 Hz), 4.07 (1H, t, *J*=2.8 Hz), 4.72 (1H, dd, *J*=9.2 and 2.8 Hz), 6.87 (2H, d, *J*=9.0 Hz), 7.96 (2H, d, *J*=9.0 Hz); $^{13}C$ NMR (100 MHz, $CD_3OD$) $\delta$ 12.98, 22.28, 25.41, 28.84, 31.35, 67.91, 74.73, 75.18, 70.67, 71.69, 72.69, 75.19, 113.69 (2C), 122.14, 131.69 (2C), 163.31, 166.35; IR (KBr) 3477 (sharp), 3358 (broad), 3250 (broad), 3160 (broad), 1691 $cm^{-1}$; Anal. Calcd for $C_{19}H_{28}O_8$: C, 59.36; H, 7.34. Found: C, 59.14; H, 7.07.

*4.6.11. DL-1-O-Pivaloyl-myo-inositol (**16c**).* Mp 202–203 °C (MeOH/AcOEt) (lit.[42] 202–204 °C); $^1H$ NMR (270 MHz, $CD_3OD$) $\delta$ 1.24 (9H, s), 3.20 (1H, t, *J*=9.2 Hz), 3.39 (1H, dd, *J*=9.7 and 2.7 Hz), 3.62 (1H, t, *J*=9.7 Hz), 3.82 (1H, t, *J*=9.7 Hz), 4.00 (1H, t, *J*=2.7 Hz), 4.58 (1H, dd, *J*=9.7 and 2.7 Hz); IR (KBr) 3545, 3460, 3392 (broad) 1714 $cm^{-1}$.

*4.6.12. DL-1-O-Hexanoyl-myo-inositol (**16d**).* $R_f$ 0.4 (MeOH/$CHCl_3$ 1:3); mp 160.0–161.5 °C (MeOH/AcOEt); $^1H$ NMR (270 MHz, $CD_3OD$) $\delta$ 0.91 (3H, br t, *J*=7.7 Hz), 1.33 (4H, complex), 1.64 (2H, br quint, *J*=7.7 Hz), 2.41 (2H, t, *J*=7.7 Hz), 3.20 (1H, t, *J*=9.7 Hz), 3.39 (1H, dd, *J*=9.7 and 2.6 Hz), 3.62 (1H, t, *J*=9.7 Hz), 3.81 (1H, t, *J*=9.7 Hz), 4.02 (1H, t, *J*=2.6 Hz), 4.61 (1H, dd, *J*=9.7 and 2.6 Hz); $^{13}C$ NMR (100 MHz, $CD_3OD$) $\delta$ 14.2, 23.3, 25.5, 32.4, 35.0, 71.6, 71.8, 72.9, 74.0, 75.6, 76.4, 175.3; IR (KBr) 3496, 3370, 3235 (broad) 1711 $cm^{-1}$; Anal. Calcd for $C_{19}H_{28}O_8$: C, 51.79; H, 7.97. Found: C, 51.59; H, 7.81.

*4.6.13. DL-1-O-Octanoyl-myo-inositol (**16e**).* $R_f$ 0.4 (MeOH/$CHCl_3$ 1:3); $^1H$ NMR (270 MHz, $CD_3OD$/$CDCl_3$ 2:1) $\delta$ 0.87 (3H, br t, *J*=7.6 Hz), 1.27 (8H, complex), 1.62 (2H, br quint, *J*=7.6 Hz), 2.40 (2H, t, *J*=7.6 Hz), 3.24 (1H, t, *J*=9.6 Hz), 3.43 (1H, br dd, *J*=9.6 and 2.1 Hz), 3.64 (1H, t, *J*=9.6 Hz), 3.82 (1H, t, *J*=9.6 Hz), 4.05 (1H, br t, *J*=2.1 Hz), 4.63 (1H, dd, *J*=9.6 and 2.1 Hz); $^{13}C$ NMR (100 MHz, $CD_3OD$/$CDCl_3$ 2:1) $\delta$ 13.4, 22.4, 24.6, 28.8, 28.9, 31.5, 33.8, 70.2, 70.4, 71.6, 72.6, 74.0, 74.9, 174.1; HRMS (ESI): calcd for $C_{14}H_{26}O_7$ [M], 306.1679; found 306.1692.

*4.6.14. Diastereomeric mixture of 1-O-(−)-menthyloxycarbonyl-myo-inositol (**16f**).*[35] $R_f$ 0.4 (MeOH/$CHCl_3$ 1:4); $^1H$ NMR (400 MHz, $CD_3OD$) (diastereomeric 69:31 mixture) $\delta$ 0.69 (3H, d, *J*=6.9 Hz), 0.82 (6H, complex), 0.95–1.34 (5H, complex), 1.60 (2H, br d), 1.95 (1H, m), 3.13 (1H, t, *J*=9.2 Hz), 3.14 (1H, t, *J*=9.3 Hz), 3.32 (2H, br d,), 3.51 (2H, br t), 3.53 (1H, t, *J*=9.2 Hz), 3.71 (2H, br d), 3.99 (1H, br t), 4.02 (1H, br t), 4.33 (1H, dd, *J*=10.0 and 2.0 Hz), 4.36 (1H, br dd), 4.43 (1H, dt, *J*=11.1 and 4.5 Hz); LRMS (FAB+, *m*-nitrobenzyl alcohol), $C_{167}H_{30}O_8$, *m*/*z*: 363 [M+1].

*4.6.15. DL-1-O-tert-Butyldiphenylsilyl-myo-inositol (**16g**).*[22b] $R_f$ 0.5 (MeOH/$CHCl_3$ 1:4); mp 163–165 °C (hexane/AcOEt); $^1H$ NMR (400 MHz, $D_2O$) $\delta$ 1.09 (9H, s), 2.98–3.02 (2H, complex), 3.51 (1H, dd, *J*=9.6 and 2.8 Hz), 3.60 (1H, t, *J*=9.6 Hz), 3.68 (1H, t, *J*=2.8 Hz), 3.81 (1H, t, *J*=9.6 Hz), 7.33–7.42 (6H, complex), 7.78 (4H, d, *J*=6.4 Hz); LRMS (FAB+, *m*-nitrobenzyl alcohol) *m*/*z*: 441 [M+Na].

*4.6.16. DL-1-O-p-Toluenesulfonyl-myo-inositol (**16h**).*[33,34] $R_f$ 0.5 (MeOH/$CHCl_3$ 1:4); mp 228–231 °C (dec. AcOH/$H_2O$, lit.[34] mp 224 °C); $^1H$ NMR (270 MHz, $D_2O$) $\delta$ 2.48 (3H, s) 3.26 (1H, t, *J*=9.4 Hz), 3.49 (1H, dd, *J*=9.4 and 2.8 Hz), 3.62 (1H, t, *J*=9.4 Hz), 3.78 (1H, t, *J*=9.4 Hz), 4.00 (1H, t, *J*=2.8 Hz), 4.40 (1H, dd, *J*=9.4 and 2.8 Hz), 7.52 (2H, d, *J*=7.9 Hz), 7.90 (2H, d, *J*=7.9 Hz); IR (KBr) 3500 (sharp), 3436 (sharp), 3345 (broad), 3235 (broad), 1358, 1173 $cm^{-1}$.

*4.6.17. DL-1-O-p-Dodecylbenzenesulfonyl-myo-inositol (**16i**).* $R_f$ 0.3 (MeOH/$CHCl_3$ 1:4); $^1H$ NMR (400 MHz, $CD_3OD$) $\delta$ 0.66–1.64 (25H, complex), 3.13 (1H, t, *J*=9.4 Hz), 3.33 (1H, br t, *J*=9.4 Hz), 3.58 (1H, t, *J*=9.4 Hz), 3.77 (1H, t, *J*=9.4 Hz), 4.06 (1H, br t), 4.28 (1H, br t, *J*=9.4 Hz), 7.38–7.58 (2H, m), 7.90 (2H, d, *J*=7.6 Hz); IR (KBr) 3500 (sharp), 3433 (sharp), 3335 (broad), 3250 (shoulder), 1358, 1175 $cm^{-1}$; HRMS (FAB+, *m*-nitrobenzyl alcohol) calcd for $C_{24}H_{41}O_8S$ [M+H] 314.1239, found 314.1235.

*4.6.18. DL-1-O-Dibutylphosphoryl-myo-inositol (**16j**).* $R_f$ 0.4 (MeOH/$CHCl_3$ 1:4); $^1H$ NMR (400 MHz, $CD_3OD$) $\delta$ 1.00 (6H, td, *J*=3.4 and 1.6 Hz), 1.48 (4H, m), 1.71 (4H, m), 3.23 (1H, t, *J*=9.5 Hz), 3.41 (1H, dd, *J*=9.5 and 2.7 Hz), 3.67 (1H, t, *J*=9.5 Hz), 3.83 (1H, t, *J*=9.5 Hz), 4.10 (1H, ddd, *J*=12.2, 9.5 and 2.7 Hz), 4.14–4.22 (5H, complex); $^{13}C$ NMR (100 MHz, $CD_3OD$) $\delta$ 14.22 (2C), 20.01 (2C), 33.62 (2C), 69.39 (2C), 72.80, 73.06, 72.13, 74.15, 76.47, 80.87; $^{31}P$ NMR (162 MHz, $CD_3OD$) $\delta$ −1.10; IR (KBr) 3400 (broad), 3324 (broad) $cm^{-1}$; LRMS (FAB+, *m*-nitrobenzyl alcohol) *m*/*z*: 373 [M+1].

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