CHEMISTRY
A EUROPEAN JOURNAL

DOI: 10.1002/chem.200600462

Apoptolidin A: Total Synthesis and Partially Glycosylated Analogues

Hermut Wehlan,[a] Mario Dauber,[a] M. Teresa Mujica Fernaud,[a] Julia Schuppan,[a] Sonja Keiper,[a] Rainer Mahrwald,[b] M.-Elisa Juarez Garcia,[a] and Ulrich Koert*[a]

Abstract: The total synthesis of apoptolidin A is described employing an early glycosylation strategy. Strategic disconnections were chosen between C11–C12 (cross-coupling) and C19O–C1 (macrocyclization). The *cis*-selective glycosylation at C9-OH was achieved with the new SIBA protective group at O2/O3 of the L-glucose residue. Auxiliary substitutents at the 2-position of the 2-deoxy sugars were applied to form selectively the glycosidic linkages of the C27 disaccharide. The cross-coupling of the glycosylated northern half with the glycosylated southern half was achieved with Cu^{I}-thiophene carboxylate. The macrocyclization of a trihydroxy carboxylic acid produced the 20-membered macrolide selectively. H_2SiF_6 was suitable for the final deprotection of the silyl ethers and the conversion of the C21 methylketal into the hemiketal. The synthetic flexibility of the approach was proven by the synthesis of some glycovariants.

Keywords: apoptolidin · cross-coupling · glycosylation · natural products · total synthesis

Introduction

The glycosidic residues of natural product glycoconjugates are usually essential for their biological function and pharmaceutical application.[1] Representative examples for the importance of the sugar moiety are the cardiac glycosides (uptake, distribution and binding activity), macrolide antibiotics (ribosome binding) and the anthracyclines (DNA interaction).[2] The ability of apoptolidin A (**1**) to selectively induce apoptosis (programmed cell death) in tumor cells also depends on the presence of the glyco residues.[3] The apoptolidins (A **1**, B **2** and C **3**) form a group of 20-membered ring macrocyclic natural products with 6-deoxy-4-*O*-methyl-L-glucose (**4**) attached to O-9 and a disaccharide consisting of L-olivomycose (**5**) and D-oleandrose (**6**) linked to O-27 (Figure 1).[3] Apoptolidin A (**1**) was isolated by Hayakawa et al. in 1997[4] and apoptolidines B (**2**) and C (**3**) by Wender in 2005[5]—all three from the soil bacteria *Nocardiopsis* sp. The apoptotic activity of the apoptolidins was attributed to the inhibition of mitochondrial F_0-F_1-ATPase.[6]

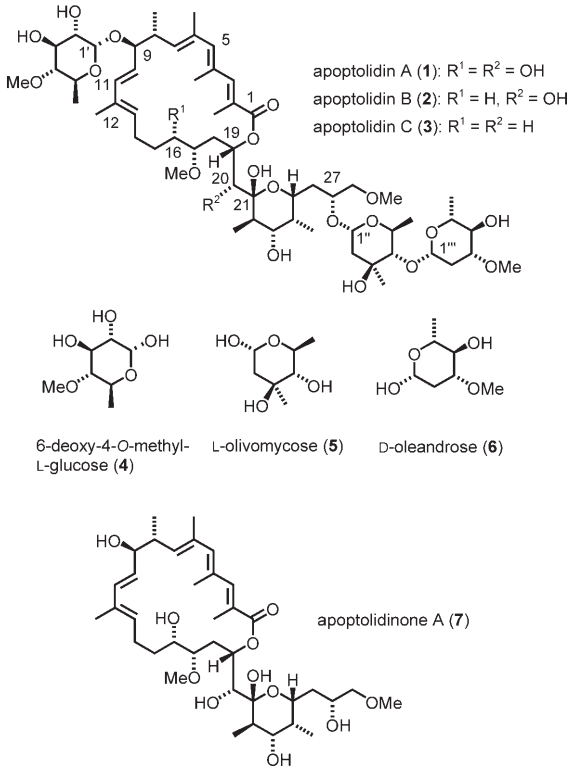


Figure 1. Structures of apoptolidin A, B, C (**1**, **2**, **3**), 6-deoxy-4-*O*-methyl-L-glucose (**4**), L-olivomycose (**5**), D-oleandrose (**6**) and apoptolidinone A (**7**).

[a] Dr. H. Wehlan, M. Dauber, Dr. M. T. M. Fernaud, Dr. J. Schuppan, Dr. S. Keiper, Dipl.-Chem. M.-E. J. Garcia, Prof. Dr. U. Koert
Fachbereich Chemie, Philipps-Universität Marburg
Hans-Meerwein-Strasse, 35032 Marburg (Germany)
Fax: (+49) 6421-282-5677
E-mail: koert@chemie.uni-marburg.de

[b] Priv.-Doz. Dr. R. Mahrwald
Institut für Chemie, Humboldt-Universität zu Berlin
Brook-Taylor-Strasse 2, 12489 Berlin (Germany)

In the course of studies on the chemistry and biology of apoptolidin A (**1**) we had synthesized the aglycone apoptolidinone A (**7**)[7] and noticed the lack of bioactivity due to the absence of the sugar residues.[3] This observation drew our attention to the introduction of the saccharide portions. The preceding manuscript detailed our synthesis of the aglycone.[8] Reported herein are the details for the preparation of the sugars, the glycosylation of the building blocks and the completion of the total synthesis of apoptolidin A (**1**).[9] The successful synthesis of apoptolidin A (**1**) has also been achieved by Nicolaou.[10] Syntheses of apoptolidinone A (**7**) were reported by Sulikowsky,[11] Crimmins[12] and by Nicolaou.[10] In addition, several valuable studies on substructures of the apoptolidins were published.[13]

Results and Discussion

As depicted in structure **8** (Figure 2) the apoptolidin glycoconjugation required the formation of an α glycoside at C1′ and C1″ as well as a β glycoside at C1‴. We intended to

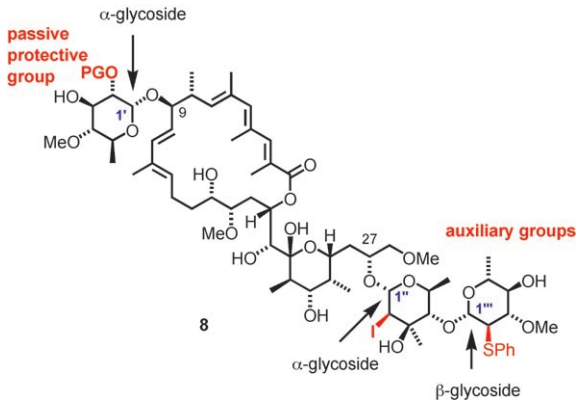
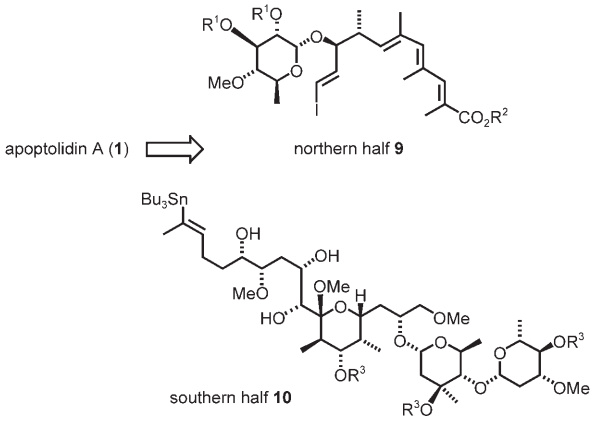


Figure 2. Glycosylation strategy for apoptolidin A (**1**).

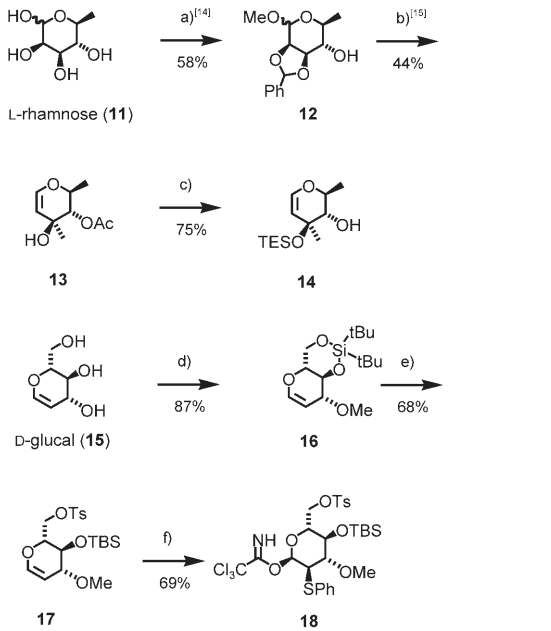
control the formation of the C1′ stereocenter via the directing anomeric effect and a passive protective group at C2′-OH. Auxiliary groups at C2″ and C2‴ were envisaged for the stereoselective formation of the glycosidic linkages at the 2-deoxy sugars.

There are two strategies for the synthesis of glycoconjugates: The complete aglycone could be synthesized and then loaded with the sugars. Alternatively, the saccharide portions could be introduced at an earlier stage before the complete assembly of the aglycon. Having already developed a convergent strategy for apoptolidinone A (**7**),[7,8] we favoured the second option in order to keep the advantages of a convergent strategy. We also expected to avoid difficulties with protective group differentiation, a major disadvantage which would challenge us with the selective glycosylation of apoptolidinone A (**7**). For these reasons our synthetic strategy for apoptolidin A (**1**) was based on an early introduction of the sugar moieties and a late cross-coupling of a fully glycosylated northern half **9** with a fully glycosylated southern half **10** (Scheme 1). A ring-size selective macrolactonization without differentiation of the C16, C19 and C20 OH groups followed by a global deprotection was planned for the last stage of the synthesis.



Scheme 1. Retrosynthetic analysis of apoptolidin A (**1**).

The synthesis of the O27 disaccharide required the preparation of an L-olivomycose and a D-oleandrose building block (Scheme 2). Starting from L-rhamnose (**11**) the 2,3-benzylidine protected methyl acetal **12** was available.[14] The latter could be converted with an excess of methyllithium via a cyclohexenone intermediate to the glycal **13**, which was O3-TES-protected to the olivomycal building block **14**.[15] Without protection of the 3-OH group the subsequent

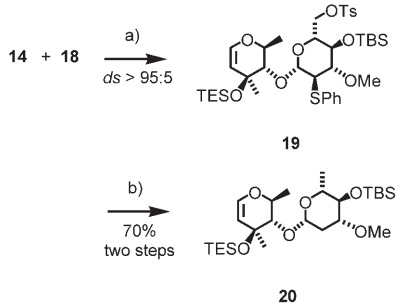


Scheme 2. a) i) MeOH, DOWEX 50WX-8-200; ii) $PhCH(OMe)_2$, *p*TsOH, DMF; b) i) MeLi, THF, 20 °C; ii) Ac_2O, pyridine, DMAP, CH_2Cl_2; c) i) TESOTf, lutidine; ii) DIBAH, CH_2Cl_2, −60 °C; d) i) $tBu_2Si(OTf)_2$, 2,6-lutidine, DMF/CH_2Cl_2; ii) MeI, Ag_2O; e) i) TBAF, THF; ii) *p*TsCl, pyridine, CH_2Cl_2; iii) TBSOTf, lutidine, CH_2Cl_2; f) i) PhSCl, CH_2Cl_2; ii) Ag_2CO_3, CH_3CN/H_2O; iii) NaH, Cl_3CCN.

glycosylation with the oleandrose unit occurred not at the desired O4 but at the undesired O3 position. The unprotected tertiary allylic alcohol (O3) proved to be more reactive than the unprotected secondary alcohol (O4).

The synthesis of the oleandrose trichloroacetimidate **18** commenced with the 4,6-silyl protection of D-glucal (**15**) and a subsequent O3 methyl ether formation to give **16**. After cleavage of the disilyl ether and a O6 tosylation followed by a O4 TBS protection the glycal **17** was obtained. In preparation of a β-selective glycosylation an auxiliary SPh substituent was introduced at C2 of the D-oleandrose building block.[16] Towards this end **17** was treated first with PhSCl, then with Ag_2CO_3 in H_2O/CH_3CN and the resulting α-anomeric hemiacetal was converted into the trichloroacetimidate **18**.[17]

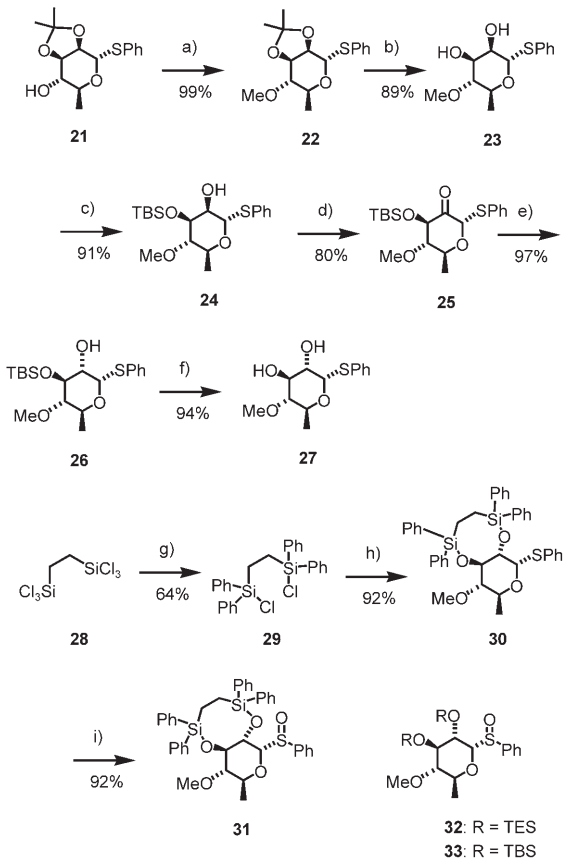
The synthesis of the L-olivomycose–oleandrose disaccharide was addressed next (Scheme 3). Activation of the trichloroacetimidate **18** with TMSOTf and treatment with the alcohol **14** led to the disaccharide **19** in 87% yield with a > 95:5 β-selectivity. The use of Et_2O as the solvent was better than CH_2Cl_2 which gave lower yields. The conversion of the tosylate in **19** into an iodide and the subsequent combined reductive removal of the iodo and the thio groups completed the preparation of the protected 2-deoxy-disaccharide building block **20**. While the reduction of the iodide occurred quite fast, the removal of the thioether required the addition of AIBN at regular intervals.



Scheme 3. a) TMSOTf, Et_2O, −60 → −40 °C, 1 h; b) i) NaI, DMF, 90 °C; ii) Bu_3SnH, AIBN, toluene, 100 °C.

L-Rhamnose was chosen as the starting material for the synthesis of the O9 sugar residue (Scheme 4). The acetonide protected L-rhamnose thioglycoside **21**[18] was O-methylated to obtain the O4 methyl ether **22**.[19] C2 oxidation/reduction inversion was intended next to convert the L-rhamnose derivative into a 6-deoxy-L-glucose building block. After acetonide cleavage, followed by O3 TBS protection (**22** → **23** → **24**), the C2 hydroxy group was addressable for oxidation. A Dess–Martin oxidation converted the alcohol **24** into the ketone **25**. A highly stereoselective reduction of **25** with $NaBH_4$ gave the corresponding alcohol, which was desilylated to the diol **27**. The stereochemical assignment of **25** was confirmed by X-ray structural analysis.[9]

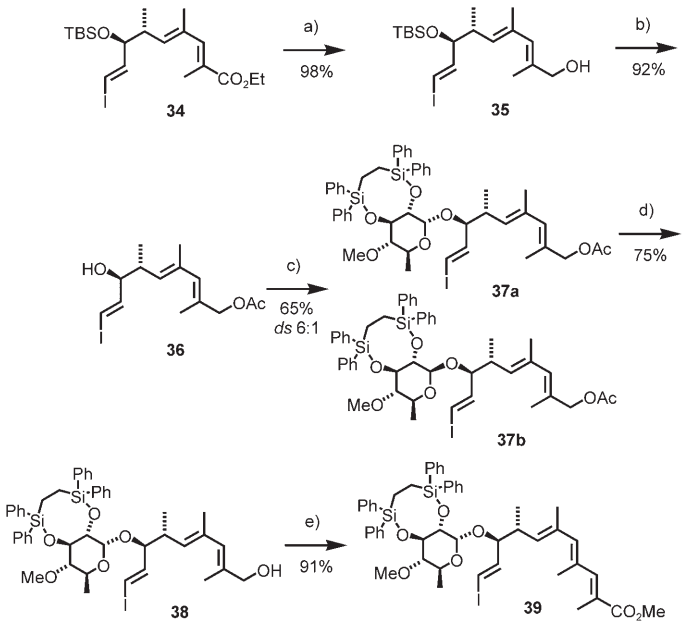
The attachment of the sugar unit **4** to O9 required a *cis*-selective glycosylation. In contrast to *trans*-selective glycosylations the *cis*-selective counterparts pose a more significant problem.[20] For our apoptolidin synthesis, the *cis*-selective glycosylation demanded a passive O2 protecting group which could be removed at the end without effecting the highly unsaturated and acid sensitive target molecule. Silyl ethers should be the best choice. After several unsuccessful glycosylation attempts (trichloroacetimidate, glycosyl fluoride, thioglycoside activation by PhSOTf) we focused on the Kahne-glycosylation via sulfoxide activation.[21] Initially we prepared and examined the bis(TES)- and bis(TBS)-protected sulfoxides **32** and **33**. However, these glycosyl donors gave unsatisfying glycosylation results (see below) which prompted us to develop a new protecting group. We reasoned that a covalent carbon bridge between the C2 and the C3 silyloxy groups might lead to a passive blocking of the C2 hydroxy function without to much steric shielding of the anomeric center. The 1,1,4,4-tetraphenyl-1,4-disilabuta-1,4-diyl substructure (SIBA) was devised as the protective group of choice. The corresponding silylating reagent 1,4-dichloro-1,1,4,4-tetraphenyl-1,4-disilabutane ($SIBACl_2$) **29** could be prepared from the hexachlorosilane **28** and phenyl magnesium bromide. The disilylation of diol **27** with $SIBACl_2$ (**29**) provided the 2,3-diprotected L-glucose thioeth-



Scheme 4. a) MeI, KOH, DMF; b) *p*TsOH, MeOH; c) TBSCl, imidazole, DMAP; d) Dess–Martin periodinane, CH_2Cl_2; e) $NaBH_4$, MeOH, 0 °C; f) TBAF, THF; g) PhMgBr, Et_2O; h) **27**, imidazole, DMF; i) MCPBA, CH_2Cl_2, −78 → −20 °C.

er **30**. In preparation of the Kahne glycosylation, **30** was oxidized with MCPBA to the sulfoxide **31**.

The following efforts focused on the synthesis of the glycosylated northern half **9** (Scheme 5). Because of the light

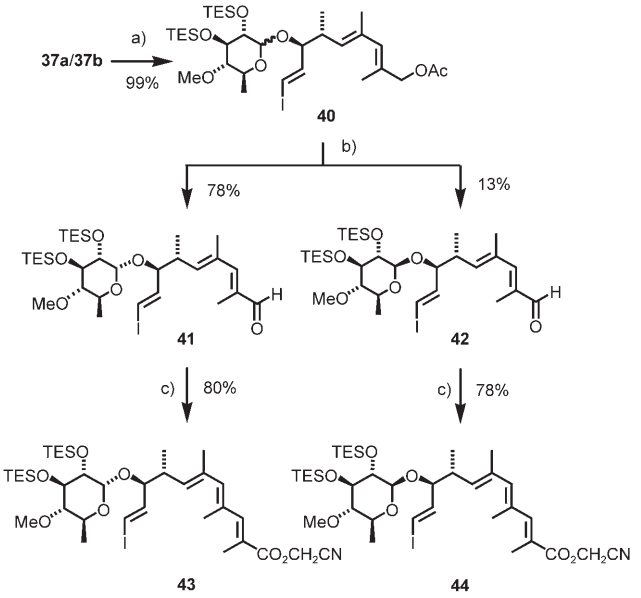


Scheme 5. a) DIBAH, toluene, −78 °C; b) i) Ac_2O, Et_3N, DMAP, CH_2Cl_2; ii) TBAF, THF; c) Tf_2O, 2,6-*tert*-butyl-4-methylpyridine, −80 °C, 10 min; addition of **31**, −80 → −35 °C, α/β 85:15; d) $LiEt_3BH$, THF, −50 °C; e) i) MnO_2, CH_2Cl_2; ii) $Ph_3P{=}C(CH_3)CO_2Me$, toluene, 90 °C.

sensitivity of the conjugated triene (in compounds of type **9**) we decided to carry out the glycosylation at the diene stage. The allylic alcohol **36** was chosen as the glycosyl acceptor. The synthesis of **36** made use of the unsaturated ester **34**[7,8] from our aglycone synthesis. DIBAH reduction of **34** gave the alcohol **35**, which was acetylated and subsequently TBS desilylated to deliver the desired glycosylation partner.

Various glycosylation conditions were evaluated for the *cis*-selective attachment of the L-glucose sugar. Initial attempts to use the bis(TES)-protected glycosyl sulfoxide **32** as glycosyl donor failed due to loss of the TES groups under the Kahne conditions (Tf_2O, DTBMP, −80 → −35 °C).[21] The more stable bis(TBS)-protected glycosylsulfoxide **33** gave the desired glycoside in 50% yield but with an unacceptable low stereoselectivity (α/β 2:1). The reaction of the SIBA-protected glycosylsulfoxide **31** with **36** under the Kahne conditions gave the two epimeric products **37a** and **37b** in 65% yield with an acceptable stereoselectivity (α/β 85:15). Other glycosylation conditions were less satisfying (NBS activation[22] of the thioether failed; trichloroacetimidate gave 60% yield, α/β 80:20). The two epimeric glycosylation products **37a** and **37b** were separable by chromatography and the desired epimer **37a** was converted via the allylic alcohol **38** and a subsequent MnO_2 oxidation/Wittig reaction sequence into the methyl ester **39**.

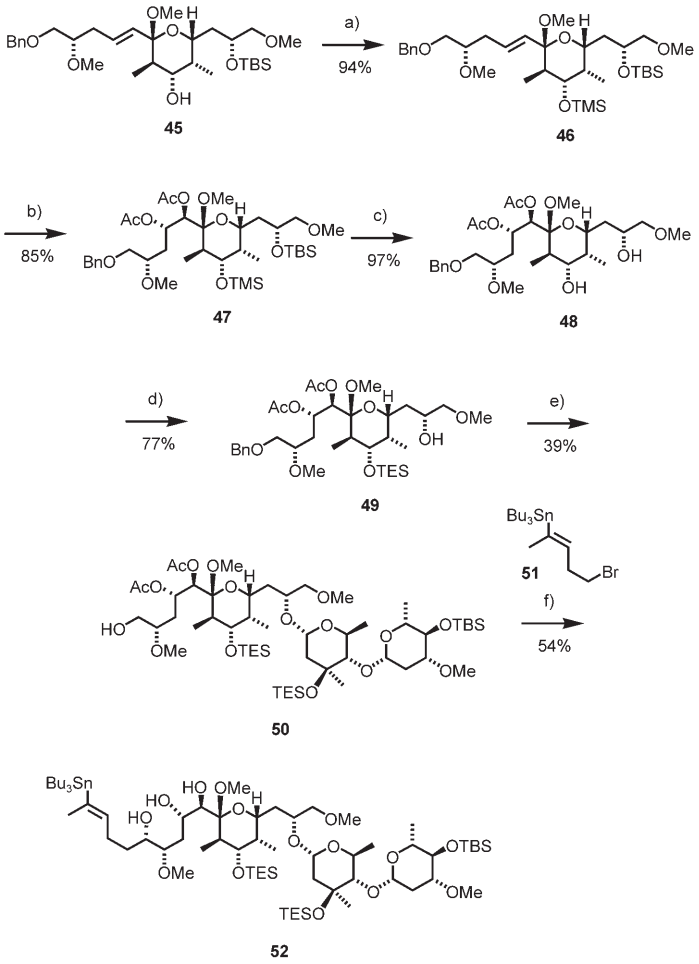
The alkenyl iodide **39** represents the complete northern half of apoptolidin A (**1**) and was used successfully in cross-coupling experiments with an alkenyl stannane of type **10**. The subsequent hydrolysis of the methyl ester of the coupling product, a prerequisite for the macrolactonization, required harsh conditions (LiOH, THF/H_2O, > 60 °C, several hours) which led to byproduct formation and yields lower than 40%. This unacceptable low yield brought us to utilize a cyanomethyl ester, which is more susceptible for nucleophilic attack than a methyl ester.[23] Guided by this idea, the cyanomethyl ester **43** was synthesized (Scheme 6). First, the



Scheme 6. a) i) TBAF, THF; ii) TESCl, imidazole; b) i) LiOH, THF/MeOH/H_2O 2:1:1; ii) MnO_2, CH_2Cl_2; c) i) $(EtO)_2P(O)CH(CH_3)CO_2H$, NaH, THF; ii) $ClCH_2CN$, Et_3N, MeCN, 20 °C.

L-glucose SIBA protection was changed to a TES protection in order to limit the number of different protective groups used in the final global deprotection. This was best accomplished with the epimeric mixture of **37a**/**37b** to give compound **40**. After cleavage of the acetate in **40** a subsequent MnO_2 oxidation of the resulting allylic alcohol gave the two unsaturated aldehydes **41** and **42**, which could be separated by chromatography easily. The aldehyde **41** was converted by a Horner–Emmons reaction into the corresponding unsaturated acid which was treated with $ClCH_2CN/Et_3N$ to yield the cyanomethyl ester **43**. The epimeric aldehyde **42** was transformed along the same route to the cyanomethyl ester **44**.

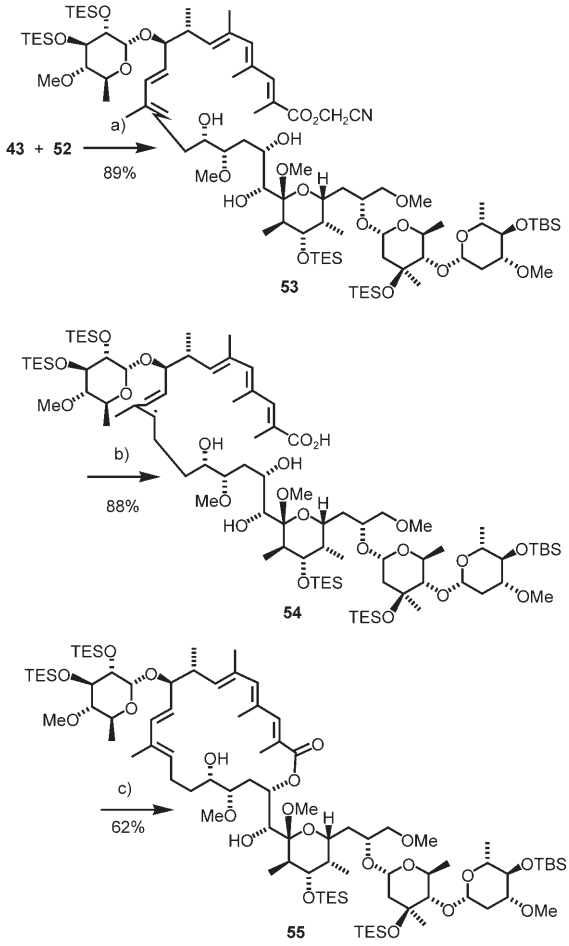
Having the northern half in hand, the synthesis of the glycosylated southern half was addressed next (Scheme 7). Starting point was the (*E*)-alkene **45** from the aglycone synthesis.[7,8] After TMS protection of the secondary alcohol group in the THP ring the O19 and O20 hydroxy groups were introduced simultaneously by a dihydroxylation using $[K_2OsO_2(OH)_4]$ and NMO. The resulting diol was converted into the diacetate **47**. The diastereoselectivity of the sub-



Scheme 7. a) TMS-imidazole, CH_2Cl_2; b) i) $[K_2OsO_2(OH)_4]$, NMO, *t*BuOH/H_2O, 0 °C; ii) Ac_2O, DMAP, pyridine; c) TBAF, THF; d) i) TESCl, imidazole, CH_2Cl_2; ii) TBAF, THF, 0 °C; e) i) **20**, NIS, MS4 Å, CH_2Cl_2, 0 → 20 °C; ii) Bu_3SnH, AIBN, toluene, 100 °C; iii) H_2, Pd/C, EtOH; f) i) Dess–Martin periodinane, pyridine, CH_2Cl_2; ii) Mg, $BrCH_2CH_2Br$, **51**, Et_2O, 20 °C, then −78 °C addition of aldehyde; 74 %, iii) KCN, MeOH, 40 °C. NMO = *N*-methylmorpholine-*N*-oxide.

strate-controlled dihydroxylation was 87:13 and the undesired minor isomer was separated by chromatography (best at the diacetate stage). The next two steps served for the deprotection of the C27 OH group and the installation of a TES protective group at C22-OH (**47** → **48** → **49**). During the course of the aglycone synthesis we had chosen a TBS protective group for C23-OH and observed a long reaction time necessary for the deprotection at this position. Therefore, in the actual situation the more labile TES ether was chosen. The alcohol **49** was allowed to react with the disaccharide glycal **20** using Thiem's NIS method[24] to deliver the corresponding α glycoside with a high α-selectivity of > 95:5. After reductive removal of the iodo group and a fluoride treatment to remove the tin impurities of the previous step, a hydrogenolytic benzyl ether cleavage led to the alcohol **50**. Without the fluoride washing, the tin impurities gave rise to numerous side products in the Pd-mediated hydrogenation of the benzyl ether. The primary alcohol **50** could be oxidized to the aldehyde, which was transformed into the complete southern half of apoptilidin A via a chelation-controlled addition[25] of the Grignard reagent prepared from **51**[7,8] to produce the corresponding alcohol with a diastereoselectivity of 96:4. Cleavage of the two acetates in the Grignard product with KCN/MeOH led to the triol **52**.

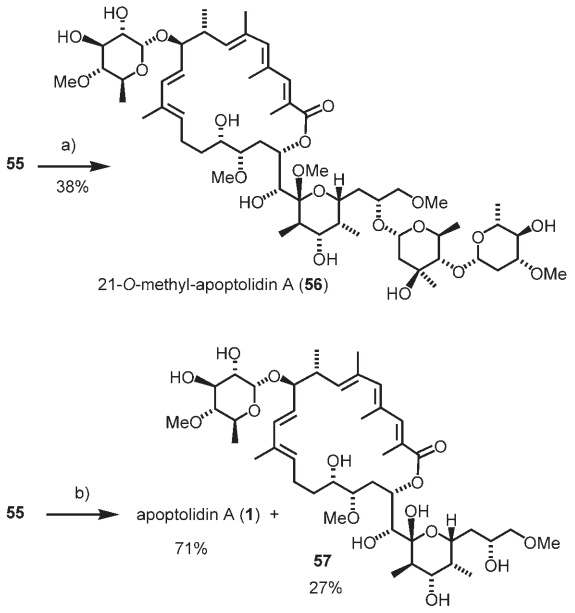
For the coupling of the northern half with the southern half we relied on our good experiences with Liebeskind's Cu^I-thiophene carboxylate (CuTC) method[26] from the apoptolidinone A work.[7,8] Much to our delight, coupling of the alkenyl iodide **43** with the alkenyl stannane **52** proceeded at 0 °C within 90 min to give the product **53** in 89 % yield (Scheme 8). Crucial for the success of the whole synthesis was the following mild hydrolysis (LiOH, 20 °C, 3 h) of the cyanomethyl ester to yield the trihydroxy carboxylic acid **54** in 88 % yield. The initial attempts to hydrolyze the corresponding methyl ester gave much lower yields. The macrocyclization of the trihydroxy carboxylic acid **54** under modified Yamaguchi conditions[27] produced the 20-membered macrolide **55** as the only product. As in the case of the aglycone,[7,8] the ring-size selectivity of this reaction is remarkable. In order to test the limitations of the ring-size selective



Scheme 8. a) Cu^I-thiophene carboxylate, *N*-methylpyrrolidinone, 0 °C; b) LiOH, THF/MeOH, 20 °C; c) 2,4,6-trichlorobenzoyl chloride, Et_3N, THF, 6 h; DMAP, toluene.

macrolactonization we examined the reaction of a substrate like **54** with a fully deprotected L-glucose at C9, which gave an unseparable mixture of numerous products.

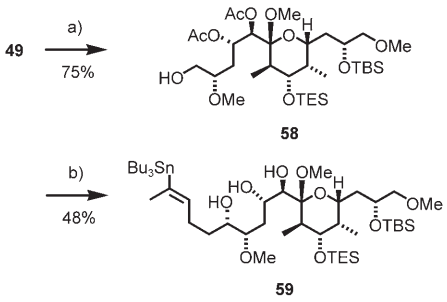
The final part of the apoptolidin A synthesis consisted in a careful examination of reagents and reaction conditions for the global deprotection (Scheme 9). While the cleavage



Scheme 9. a) HF·pyridine, THF, 20 °C, 5 d; b) H_2SiF_6 25% in H_2O, CH_3CN, −40 → −20 °C, 2 d, −10 °C, 1 d.

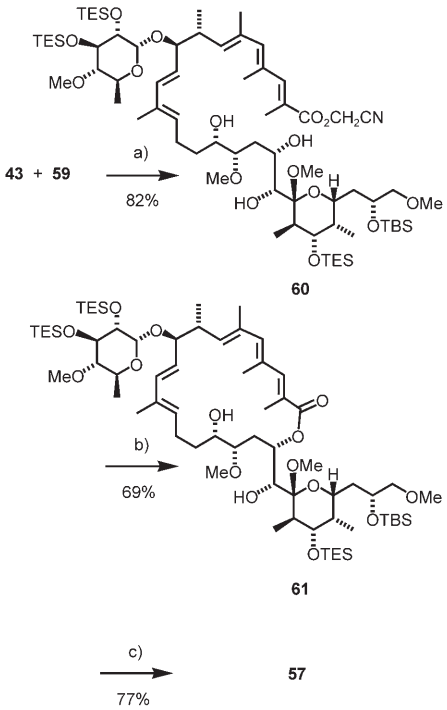
of the numerous silyl ethers was more or less standard chemistry, the conversion of the C21 methyl ketal into the hemiketal in the presence of the acid labile 2-deoxy sugars of the C27 disaccharide was very critical. First, all silyl ethers were cleaved using HF·pyridine in THF/pyridine at 20 °C for 5 d to give synthetic 21-*O*-methyl apoptolidin A (**56**) which proved to be identical with **56** derived from natural sources ($[\alpha]_D^{22} = -76$ ($c = 0.55$ in $CHCl_3$), ref. [6e]: $[\alpha]_D^{22} = -67$ ($c = 1.28$ in $CHCl_3$)). Now we turned our attention to a complete deprotection in one step leading to apoptolidin A (**1**). 25% aqueous H_2SiF_6[28] in CH_3CN at −40 → −10 °C proved to be effective for cleavage of all silyl ethers and notably the methyl ketal. Apoptolidin A (**1**) was isolated in 71% yield after chromatographic separation on desactivated silica gel.[29] In addition, the cleavage of the *O*-27-disaccharide was observed and 27-hydroxy apoptolidin A (**57**) was isolated in 27% yield. With respect to physical and spectroscopical data, the synthetic apoptolidin A (**1**) was identical with the natural one. (m.p. 129–131 °C (MeOH), ref. [4]: 128–130 °C; ($[\alpha]_D^{22} = -4.4$ ($c = 0.70$ in MeOH), ref. [4]: $[\alpha]_D^{22} = -5.2$ ($c = 1.0$ in MeOH).

With an efficient access to the natural product itself, the way was paved for the synthesis of apoptolidin derivatives. We intended to investigate the role of the sugar moieties and focused on two points: the presence or absence of the C27 disaccharide and the stereochemistry of the C9 glycosidic linkage. Towards this goal, a southern building block lacking the C27 disaccharide was prepared (Scheme 10). The secondary alcohol in **49** was C27-OH TBS protected to yield after benzyl ether cleavage the primary alcohol **58**. The latter was Dess–Martin oxidized to the corresponding aldehyde. Addition of the Grignard reagent prepared from **51** to this aldehyde gave after cleavage of the acetates the alkenyl stannane **59**.



Scheme 10. a) i) TBSCl, imidazole, CH_2Cl_2; ii) H_2, Pd/C, EtOH; b) i) Dess–Martin periodinane, pyridine, CH_2Cl_2; ii) Mg, $BrCH_2CH_2Br$, **51**, Et_2O, 20 °C, then −78 °C addition of aldehyde; 74%, iii) KCN, MeOH, 40 °C.

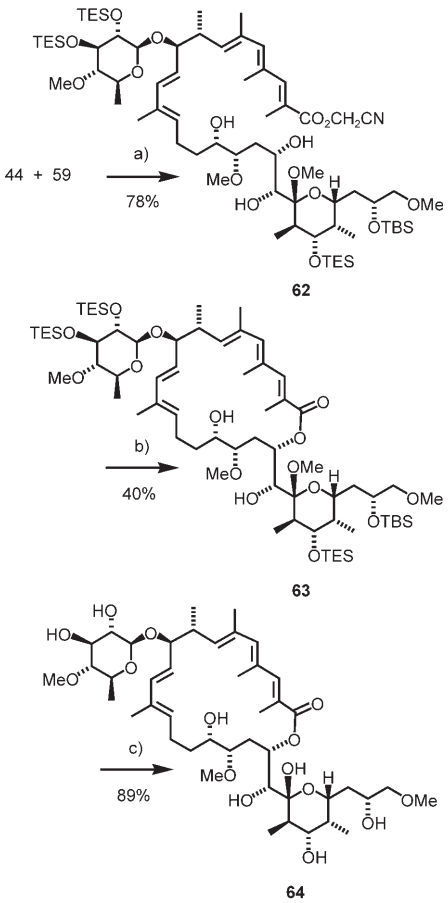
Cross-coupling of **59** with the α-glycosylated alkenyl iodide **43** led to the product **60** (Scheme 11). After hydrolysis of the cyanomethyl ester the resulting trihydroxy carboxylic acid could be cyclized to the 20-membered macrolide



Scheme 11. a) Cu^I-thiophene carboxylate, *N*-methylpyrrolidinone, 0 °C; b) i) LiOH, THF/MeOH, 20 °C; ii) 2,4,6-trichlorobenzoyl chloride, Et_3N, THF, 6 h; DMAP, toluene; c) H_2SiF_6 25% in H_2O, CH_3CN, −40 → −10 °C.

61. The deprotection of all silyl ethers and conversion of the C21 methyl ketal into the hemiketal yielded the 27-OH apoptolidin A (**57**), a derivative of the natural product with the disaccharide missing.

The role of the stereochemistry at the C9 glycosidic linkage was addressed by the synthesis of compound **64** (Scheme 12). The β-glycosylated alkenyl iodide **44** was



Scheme 12. a) Cu^{I}-thiophene carboxylate, *N*-methylpyrrolidinone, 0 °C; b) i) LiOH, THF/MeOH, 20 °C; ii) 2,4,6-trichlorobenzoyl chloride, Et_3N, THF, 6 h; DMAP, toluene; c) H_2SiF_6 25% in H_2O, CH_3CN, −40 → −10 °C.

cross-coupled with the alkenyl stannane **59** to yield **62**. The ester hydrolysis followed by macrocyclization to **63** and a final deprotection resulted in **64**, a derivative of apoptolidine A, which is epimeric at C1′ of the L-glucose and lacks the disaccharide at the C27 position.

The antitumor activity of apoptolidin A (**1**) and its glycovariants was tested for MATU breast cancer cells.[3] The IC_{50} values for apoptolidin A (**1**, 1 nM) and 21-*O*-methyl apoptolidin (**56**, 2 nM) exhibit for both compounds a very strong activity. The C21 methyl ketal has no pronounced effect. 27-OH Apoptolidin A (**57**), the glycovariant with no disaccharide at the C27 position showed a strong decrease in the cytotoxicity (IC_{50} = 3 μM). Finally, the change of the α-glycoside to a β-glycosidic linkage to the C9 sugar residue resulted in an additional decrease of activity (**64**, IC_{50} > 10 μM). These data show the importance of the disaccharide portion and the stereochemistry of the C9 glycosidic linkage for the bioactivity of apoptolidine A (**1**).

Conclusion

To summarize, a stereoselective total synthesis of apoptolidin A (**1**) has been achieved. The efficiency of our synthetic strategy results from the high convergence. This convergence was possible due to the early introduction of the sugar residues using a new sugar protecting group (SIBA). Key steps of the synthesis were a Cu^{I}-mediated cross-coupling followed by a ring-size selective macrolactonization, the mild hydrolysis of the cyanomethyl ester and the use of H_2SiF_6 for the global deprotection. The variability of the approach was proven by the synthesis of some glycovariants of apoptolidin. The synthetic products are of interest for further apoptosis studies and have potential for antitumor therapy.

Experimental Section

General methods: All reactions sensitive to air or moisture were conducted in flame-dried glassware under an atmosphere of dry Argon. THF and Et_2O were distilled from sodium/benzophenone. CH_2Cl_2, toluene, hexanes, pyridine, and Et_3N were distilled from CaH_2. All starting materials and reagents were used as received unless noted otherwise. Thin layer chromatography was performed on glass-supported Merck silica gel 60 F_{254} plates. Spots were visualized by UV light and by heat staining with 2% molybdophosphoric acid in ethanol. Column chromatography was performed on Merck silica gel 60 (63–200 μm). Melting points were measured with a Büchi melting point apparatus and are not corrected. IR Spectra were measured with a Bruker FT-IR spectrometer. ^1H and ^{13}C NMR spectra were recorded with Bruker spectrometers ARX-200, AC-300, AV-300, AMX-400, DRX-400, DRX-500, DRX-600. $CDCl_3$ was used as normal solvent. TMS was used as internal standard. Optical rotations: Perkin-Elmer polarimeter 241, cuvette path length 10 cm; $CHCl_3$ for spectroscopy was filtered over basic aluminium oxide before use. Microanalysis: CHN rapid, Heraeus. HRMS: Finnigan LTQ FT (ESI). MTBE = *tert*-butyl methyl ether; PE = petrol ether (b.p. range 60–60 °C.

3-*O*-Triethylsilyl-L-olivomycal (14): *TES protection:* Alcohol **13**[14] (960 mg, 5.20 mmol) was dissolved in CH_2Cl_2 (50 mL) and cooled to −60 °C. Then 2,6-lutidine (2.8 mL, 24 mmol) and TESOTf (2.0 mL, 7.8 mmol) were added. After stirring for 30 min at −60 °C the reaction was quenched by addition of $NaHCO_3$ (50 mL). The aqueous layer was extracted with CH_2Cl_2 (3 × 30 mL). The combined organic layers were washed with brine (15 mL), dried with Na_2SO_4 and concentrated.

Acetate deprotection: The crude TES ether was azeotroped with toluene (3 × 10 mL), dissolved in CH_2Cl_2 (50 mL), cooled to −78 °C, and DIBAH (10 mL, 1.0 M in PE, 10 mmol) was added dropwise within 15 min. After stirring for 45 min at −78 °C, the reaction was quenched by addition of MeOH (1.6 mL). The reaction mixture was added to a solution of Rochelles salt (100 mL, 1.0 M). After 1 h stirring, the two layers were separated and the aqueous layer was extracted with CH_2Cl_2 (3 × 40 mL). The combined organic layers were washed with brine (80 mL), dried with Na_2SO_4, concentrated and the residue was purified by flash chromatography (100 g neutral silica gel, pentane/MTBE 8:1) to yield tertiary alcohol **14** (1.0 g, 3.9 mmol, 75% over 2 steps) as a colorless oil. R_f = 0.39 (*n*-hexane/MTBE 4:1); $[\alpha]_D^{20}$ = +13.1 (*c* = 0.99, $CHCl_3$); ^1H NMR (300 MHz, C_6D_6): δ = 0.59 (q, *J* = 7.9 Hz, 6H, $SiCH_2CH_3$), 0.98 (t, *J* = 7.7 Hz, 9H,

$SiCH_2CH_3$), 1.30 (s, 3H, 3-CH_3), 1.36 (d, J=6.1 Hz, 3H, 6-H_3), 1.73 (d, J=3.4 Hz, 1H, OH), 3.67 (dd, J=10.0, 3.4 Hz, 1H, 4-H), 3.79 (dq, J=10.0, 6.1 Hz, 1H, 5-H), 4.63 (d, J=6.1 Hz, 1H, 2-H), 6.02 (d, J=6.1 Hz, 1H, 1-H); ^{13}C NMR (75 MHz, C_6D_6): δ=6.9, 7.3 ($SiCH_2CH_3$), 18.1 (C-6), 25.7 (3-CH_3), 73.6 (C-3), 74.0 (C-5), 78.7 (C-4), 108.4 (C-2), 142.6 (C-1); IR (film): $\tilde{\nu}$=3500 (brs), 3064 (m), 2956 (s), 2911 (s), 2877 (s), 1644 (s), 1456 (s), 1230 (s), 1133 (s), 1074 (s), 863 (s), 740 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{13}H_{26}O_3SiNa$: 281.1549; found 281.1538 $[M+Na]^+$.

4,6-*O*-(Di-*tert*-butyl)-silyliden-3-*O*-methyl-D-glucal (16): *Silyl ether formation:* D-Glucal (**15**) (5.00 g, 34.2 mmol) was dissolved in DMF/CH_2Cl_2 1:1 (170 mL) and cooled to −5 °C. 2,6-lutidine (12.0 mL, 103 mmol) and $t$$Bu_2SiOTf_2$ (13.7 mL, 37.6 mmol) were added. The mixture was stirred for 2 h at 20 °C. The reaction was quenched with $NaHCO_3$ (300 mL). The aqueous layer was extracted with CH_2Cl_2 (3×100 mL). The combined organic layers were dried with Na_2SO_4, concentrated and the residue was purified by flash chromatography (200 g silica gel, pentane/MTBE 9:1) to yield the 4,6-disilylated product (9.35 g, 32.6 mmol, 95%) as a white solid. M.p. 79 °C (pentane); R_f=0.49 (n-hexane/MTBE 5:2); $[\alpha]_D^{22}$=−16.3 (c=2.86, $CHCl_3$); ^{1}H NMR (400 MHz, C_6D_6): δ=1.00, 1.03 (2s, 18H, $SiC(CH_3)_3$), 2.41–2.51 (brs, 1H, OH), 3.70 (ddd, J=10.3, 10.3, 5.1 Hz, 1H, 5-H), 3.89 (t, J=10.4 Hz, 1H, 6-H_α), 3.94 (dd, J=10.2, 7.3 Hz, 1H, 4-H), 4.10 (dd, J=10.3, 5.1 Hz, 1H, 6-H_β), 4.18 (ddd, J=7.3, 1.7, 1.7 Hz, 1H, 3-H), 4.69 (dd, J=6.1, 1.8 Hz, 1H, 2-H), 6.02 (dd, J=6.1, 1.8 Hz, 1H, 1-H); ^{13}C NMR (100.6 MHz, C_6D_6): δ=19.9, 22.8 ($SiC(CH_3)_3$), 27.1, 27.6 ($SiC(CH_3)_3$), 66.1 (C-6), 70.2 (C-3), 72.7 (C-5), 77.9 (C-4), 104.2 (C-2), 143.3 (C-1); IR (film): $\tilde{\nu}$=3455 (brs), 3084 (s), 2935 (s), 2895 (s), 2860 (s), 1643 (s), 1473 (s), 1234 (s), 1123 (s), 1056 (s), 827 (s), 756 cm^{-1} (s); elemental analysis calcd (%) for $C_{14}H_{26}O_4Si$ (286.44): C 58.70, H 9.15; found C 58.56, H 9.27.

Methyl ether formation: $CaSO_4$ (16.2 g, 119 mmol) and Ag_2O (17.3 g, 74.5 mmol) were added at 20 °C to a solution of the alcohol (8.53 g, 29.8 mmol) in MeI (40 mL). The mixture was stirred for 14 h at 20 °C. Then Et_2O (50 mL) was added, the suspension was filtered over a pad of Celite and washed with Et_2O (100 mL). The solvents were removed and the residue was purified by flash chromatography (200 g silica gel, pentane/MTBE 9:1, 0.5% Et_3N) to yield methyl ether **16** (8.22 g, 27.4 mmol, 92%) as a white amorphous solid. M.p. 32 °C (pentane); R_f=0.49 (n-hexane/MTBE 9:1); $[\alpha]_D^{21}$=−13.2 (c=2.71, $CHCl_3$); ^{1}H NMR (300 MHz, C_6D_6): δ=1.02 (s, 18H, $SiC(CH_3)_3$), 3.41 (s, 3H, OCH_3), 3.73 (dt, J=10.3, 5.1 Hz, 1H, 5-H), 3.86 (dt, J=7.1, 1.8 Hz, 1H, 3-H), 3.92 (t, J=10.4 Hz, 1H, 6-H_α), 4.13 (dd, J=10.3, 4.9 Hz, 1H, 6-H_β), 4.21 (dd, J=10.3, 7.1 Hz, 1H, 4-H), 4.70 (dd, J=6.1, 2.0 Hz, 1H, 2-H), 6.05 (dd, J=6.1, 1.5 Hz, 1H, 1-H); ^{13}C NMR (100.6 MHz, C_6D_6): δ=19.9, 22.7 ($SiC(CH_3)_3$), 27.2, 27.5 ($SiC(CH_3)_3$), 57.9 (OCH_3), 66.2 (C-6), 72.9 (C-5), 77.0 (C-4), 78.9 (C-3), 102.7 (C-2), 143.7 (C-1); IR (film): $\tilde{\nu}$=3073 (s), 2934 (s), 2890 (s), 2860 (s), 1650 (s), 1473 (s), 1235 (s), 1159 (s), 1081 (s), 1058 (s), 869 (s), 769 cm^{-1} (s); HR-MS (EI): m/z: calcd for $C_{15}H_{28}O_4Si$: 300.1757; found 300.1758 $[M]^+$.

4-*O*-*tert*-Butyldimethylsilyl-3-*O*-methyl-6-*O*-tosyl-D-glucal (17): *Desilylation:* TBAF (8.31 g, 26.4 mmol) was added in portions at 0 °C to a solution of disilyl ether **16** (7.92 g, 26.4 mmol) in THF (100 mL). After stirring for 3 h at 0 °C, the yellow solution was added to brine (100 mL) and ice (50 g). The aqueous layer was extracted with MTBE (3×50 mL). The combined organic layers were dried with Na_2SO_4, concentrated and the residue was purified by flash chromatography (100 g silica gel, $CHCl_3$/MeOH 30:1) to yield the corresponding diol (3.11 g, 19.4 mmol, 74%) as a white solid. M.p. 65 °C (CH_2Cl_2); R_f=0.53 ($CHCl_3$/MeOH 11:2); $[\alpha]_D^{20}$=−43.5 (c=0.77, $CHCl_3$); ^{1}H NMR (400 MHz, C_6D_6): δ=2.49 (dd, J=7.3, 5.7 Hz, 1H, 6-OH), 3.14 (s, 3H, OCH_3), 3.24 (d, J=4.4 Hz, 1H, 4-OH), 3.65–3.97 (m, 5H, 6-H_2, 3-H, 4-H, 5-H), 4.61 (dd, J=6.1, 1.9 Hz, 1H, 2-H), 6.13 (d, J=6.1 Hz, 1H, 1-H); ^{13}C NMR (100.6 MHz, C_6D_6): δ=55.9 (OCH_3), 62.0 (C-6), 68.3, 78.5, 78.7 (C-4, C-5, C-3), 100.1 (C-2), 144.6 (C-1); IR (film): $\tilde{\nu}$=3384 (brs), 2936 (s), 1649 (m), 1457 (m), 1391 (m), 1235 (s), 1190 (m), 1085 (s), 964 (m), 748 cm^{-1} (m); elemental analysis calcd (%) for $C_7H_{12}O_4$ (160.17): C 52.49, H 7.55; found C 52.27, H 7.72.

Tosylation: The diol (2.00 g, 12.5 mmol) was dissolved in CH_2Cl_2 (70 mL) and cooled to 0 °C. Pyridine (1.2 mL, 15 mmol) and TsCl (2.50 g, 13.1 mmol) were added. After stirring for 14 h at 20 °C the mixture was added to ice (100 g) and the aqueous layer was extracted with MTBE (3×30 mL). The combined organic layers were washed with brine (30 mL), dried with Na_2SO_4 and concentrated. The residue was purified by flash chromatography (100 g silica gel, pentane/MTBE 2:1) to give the tosylate (3.70 g, 11.8 mmol, 94%) as a yellow oil. R_f=0.45 ($CHCl_3$/MeOH 20:1); $[\alpha]_D^{22}$=+5.7 (c=0.49, $CHCl_3$); ^{1}H NMR (200 MHz, C_6D_6): δ=1.77 (s, 3H, Ph-CH_3), 2.04 (d, J=3.5 Hz, 1H, OH), 3.00 (s, 3H, OCH_3), 3.46–3.55 (m, 1H, 3-H), 3.61–3.74 (m, 2H, 4-H, 5-H), 4.21 (dd, J=11.0, 1.8 Hz, 1H, 6-H), 4.33 (dd, J=10.9, 4.6 Hz, 1H, 6-H), 4.50 (dd, J=6.1, 2.4 Hz, 1H, 2-H), 5.95 (dd, J=6.1, 1.4 Hz, 1H, 1-H), 6.62 (d, J=8.5 Hz, 2H, arom.), 7.72 (d, J=8.3 Hz, 2H, arom.); ^{13}C NMR (50 MHz, C_6D_6): δ=21.1 (Ph-CH_3), 55.8 (OCH_3), 67.2 (C-4), 68.1 (C-6), 76.1 (C-5), 77.7 (C-3), 100.1 (C-2), 129.7 (CH, arom.), 144.0 (C-1); IR (film): $\tilde{\nu}$=3376 (brs), 2935 (s), 1648 (s), 1364 (s), 1176 (s), 1094 (s), 981 (s), 954 (s), 832 (s), 672 cm^{-1} (s); elemental analysis calcd (%) for $C_{14}H_{18}O_6S$ (314.35): C 53.49, H 5.77; found C 53.66, H 5.65.

TBS protection: The alcohol (1.80 g, 5.74 mmol) was dissolved in CH_2Cl_2 (50 mL) and cooled to −60 °C. 2,6-lutidine (2.0 mL, 17 mmol) and TBSOTf (1.45 mL, 6.30 mmol) were added. The reaction was stirred for 2 h at −60 °C and was then quenched with $NaHCO_3$ (50 mL). The aqueous layer was extracted with CH_2Cl_2 (3×50 mL). The combined organic layers were washed with brine (50 mL), dried with Na_2SO_4, concentrated and the residue was purified by flash chromatography (150 g silica gel, pentane/MTBE 11:2) to yield silyl ether **17** (2.40 g, 5.60 mmol, 98%) as a colorless oil. R_f=0.56 (n-hexane/MTBE 2:1); $[\alpha]_D^{22}$=+19.6 (c=0.96, $CHCl_3$); ^{1}H NMR (400 MHz, C_6D_6): δ=0.12, 0.13 (2s, 6H, $SiCH_3$), 0.93 (s, 9H, $SiC(CH_3)_3$), 1.81 (s, 3H, Ph-CH_3), 2.93 (s, 3H, OCH_3), 3.50 (d, J=6.2 Hz, 1H, 3-H), 3.73–3.79 (m, 1H, 5-H), 3.83 (dd, J=8.9, 6.3 Hz, 1H, 4-H), 4.30 (dd, J=10.8, 5.5 Hz, 1H, 6-H), 4.39 (dd, J=10.8, 2.2 Hz, 1H, 6-H), 4.52 (dd, J=6.1, 2.1 Hz, 1H, 2-H), 6.01 (d, J=6.0 Hz, 1H, 1-H), 6.68 (d, J=8.4 Hz, 2H, arom.), 7.77 (d, J=8.2 Hz, 2H, arom.); ^{13}C NMR (100.6 MHz, C_6D_6): δ=−5.1, −4.1 ($SiCH_3$), 18.3 ($SiC(CH_3)_3$), 21.1 (Ph-CH_3), 26.1 ($SiC(CH_3)_3$), 54.9 (OCH_3), 68.4 (C-4), 68.5 (C-6), 76.7 (C-5), 78.4 (C-3), 99.4 (C-2), 129.7 (CH, arom.), 134.2 (C_q, arom.), 144.1 (C-1), 144.2 (C_q, arom.); IR (film): $\tilde{\nu}$=2954 (s), 2930 (s), 1495 (s), 1363 (s), 1177 (s), 1097 (s), 973 (s), 872 (s), 837 cm^{-1} (s); elemental analysis calcd (%) for $C_{20}H_{32}O_6SSi$ (428.61): C 56.04, H 7.53; found C 56.35, H 7.27.

***O*-(4-*O*-*tert*-Butyldimethylsilyl-2-deoxy-3-*O*-methyl-2-thiophenyl-6-*O*-tosyl-α-D-glucopyranosyl)trichloroacetimidate (18)**: *Thiophenol addition:* PhSH (200 μL, 1.95 mmol) was slowly added to a solution of NCS (260 mg, 1.95 mmol) in CH_2Cl_2 (4 mL) and 4 Å MS (100 mg) at 20 °C. The orange colored solution was stirred for 30 min and was then added via dropping funnel to glycal **17** (750 mg, 1.75 mmol) in CH_2Cl_2 (6 mL) at 20 °C. After 1 h stirring the solvent was removed in vacuo and the residue was dried for 30 min in vacuo. The crude product was dissolved in MeCN/H_2O (25 mL, 9:1). Ag_2CO_3 (2.0 g, 7.3 mmol) was added and mixture was stirred for 14 h at 20 °C. THF (5 mL) was added, the suspension was filtered over a pad of celite and washed with AcOEt (30 mL). The solvents were removed and the residue was purified by flash chromatography (100 g silica gel, pentane/MTBE 5:1) to yield the corresponding α-glucopyranose (845 mg, 1.52 mmol, 87%) as a white solid. M.p. 125 °C (pentane); R_f=0.36 (n-hexane/MTBE 2:1); $[\alpha]_D^{23}$=+43.0 (c=1.63, $CHCl_3$); ^{1}H NMR (400 MHz, C_6D_6): δ=0.11, 0.13 (2s, 6H, $SiCH_3$), 0.90 (s, 9H, $SiC(CH_3)_3$), 1.82 (s, 3H, Ph-CH_3), 2.56 (d, J=2.7 Hz, 1H, OH), 3.08 (dd, J=10.8, 2.7 Hz, 1H, 2-H), 3.45 (s, 3H, OCH_3), 3.48 (dd, J=9.0, 8.9 Hz, 1H, 4-H), 3.57 (dd, J=10.6, 8.6 Hz, 1H, 3-H), 4.01–4.08 (m, 1H, 5-H), 4.26 (dd, J=10.5, 5.2 Hz, 1H, 6-H), 4.37 (dd, J=10.4, 2.0 Hz, 1H, 6-H), 4.98 (dd, J=3.0, 3.0 Hz, 1H, 1-H), 6.74 (d, J=8.7 Hz, 2H, arom.), 6.89–6.97 (m, 1H, Ph), 7.00 (t, J=7.4, 2H, Ph), 7.45 (d, J=7.1 Hz, 2H, Ph), 7.83 (d, J=8.2 Hz, 2H, arom.); ^{13}C NMR (100.6 MHz, C_6D_6): δ=−4.7, −3.7 ($SiCH_3$), 18.1 ($SiC(CH_3)_3$), 21.1 (Ph-CH_3), 26.1 ($SiC(CH_3)_3$), 55.4 (C-2), 61.6 (OCH_3), 69.4 (C-6), 70.8 (C-5), 72.5 (C-4), 83.5 (C-3), 93.8 (C-1), 126.1, 128.4, 129.2, 129.8, 130.8 (CH, arom.), 134.2, 137.0, 144.3 (C_q, arom.); IR (film): $\tilde{\nu}$=3525 (brs), 2954 (s), 2930 (s), 1176 (s), 1088 (s), 1022 (s), 986 (s), 837 (s), 815 (s), 754 cm^{-1} (s); elemental analysis calcd (%) for $C_{26}H_{38}O_7S_2Si$ (554.79): C 56.29, H 6.90; found C 56.06, H 7.00.

Trichloroacetimidate formation: The α-glucopyranose (300 mg, 541 μmol) was dissolved in Cl_3CCN (5.5 mL) and cooled to −40 °C. NaH (108 mg, 2.71 mmol, 60 % in mineral oil) was added in portions and the mixture was allowed to warm to −5 °C within 2 h. The reaction was quenched by careful addition of phosphate buffer (5 mL, 1 M, pH 7) and MTBE (10 mL). After separation of the two layers, the aqueous layer was extracted with MTBE (3×20 mL). The combined organic layers were washed with brine (10 mL), dried with Na_2SO_4, concentrated and the residue was purified by flash chromatography (25 g silica gel, neutral, pentane/MTBE 5:1) to yield amorphous trichloroacetimidate **18** (300 mg, 429 μmol, 79 %) as the pure α-anomer. R_f=0.36 (*n*-hexane/MTBE 2:1); $[\alpha]_D^{23}$=+43.0 (*c*=1.63, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ=0.17, 0.20 (2 s, 6 H, $SiCH_3$), 0.90 (s, 9 H, $SiC(CH_3)_3$), 1.79 (s, 3 H, Ph-CH_3), 3.15 (dd, *J*=10.5, 3.4 Hz, 1 H, 2-H), 3.53 (s, 3 H, OCH_3), 3.61–3.72 (m, 2 H, 3-H, 4-H), 4.13–4.19 (m, 1 H, 5-H), 4.31 (dd, *J*=11.5, 3.9 Hz, 1 H, 6-H), 4.43 (dd, *J*=10.8, 2.1 Hz, 1 H, 6-H), 6.57 (d, *J*=3.4 Hz, 1 H, 1-H), 6.68 (d, *J*=8.7 Hz, 2 H, arom.), 6.91–7.01 (m, 3 H, Ph), 7.39–7.42 (m, 2 H, Ph), 7.77 (d, *J*=8.3 Hz, 2 H, arom.), 8.52 (s, 1 H, NH); ^{13}C NMR (125.8 MHz, C_6D_6): δ=−4.6, −3.6 ($SiCH_3$), 18.2 ($SiC(CH_3)_3$), 21.1 (Ph-CH_3), 26.2 ($SiC(CH_3)_3$), 55.1 (C-2), 61.7 (OCH_3), 68.5 (C-6), 71.7 (C-4), 73.9 (C-5), 83.7 (C-3), 91.6 (-CCl_3), 96.7 (C-1), 127.3, 128.3, 129.3, 129.7, 131.7 (CH, arom.), 134.2, 135.9, 144.3 (C_q, arom.), 160.6 (C=NH); IR (film): $\tilde{\nu}$= 3454 (br s), 3062 (w), 2957 (s), 2926 (s), 2898 (m), 2853 (s), 1674 (s), 1468 (m), 1364 (s), 1280 (m), 1190 (s), 1170 (s), 986 (s), 830 (m), 796 cm^{-1} (m).

4-*O*-(4-*O*-*tert*-Butyldimethylsilyl-3-*O*-methyl-β-D-oleandropyranosyl)-3-*O*-triethylsilyl-L-olivomycal (20): Glycosyl acceptor **14** (850 mg, 1.22 mmol) and glycosyl donor **18** (286 mg, 1.11 mmol) were combined and azeotroped with toluene (3×10 mL). After drying under high vacuum for one hour, the mixture was dissolved in Et_2O (25 mL), MS 4 Å (1.25 g, powder) was added and the suspension was stirred for 1 h at 20 °C. The mixture was cooled to −60 °C and TMSOTf (6.5 μL, 36 μmol) was added via 10 μL glass syringe. The mixture was allowed to warm to −40 °C within 1 h and was then quenched by addition of NEt_3 (1 mL). $NaHCO_3$ (10 mL) was added and the molecular sieve was filtered over a pad of Celite. The aqueous layer was extracted with MTBE (3×25 mL). The combined organic layers were washed with brine (60 mL), dried with Na_2SO_4, concentrated and filtered over 10 g silica gel (neutral) with pentane/MTBE 15:1. The solvents were removed and crude disaccharide **19** obtained was used for the next step without further purification (*n*-hexane/MTBE 4:1; R_f=0.47). The disaccharide was azeotroped with toluene (3×5 mL), dried under high vacuum for 30 min and was dissolved in DMF (10 mL). NaI (2.25 g, 15.0 mmol) was added and mixture was stirred for 2 h at 90 °C. After cooling, $NaHCO_3$ (10 mL) and aq $Na_2S_2O_3$ (20 %; 3 mL) were added. The aqueous layer was extracted with MTBE (3×30 mL). The combined organic layers were washed with brine (30 mL), dried with Na_2SO_4 and concentrated. The crude iodide was dissolved in toluene (10 mL) and Bu_3SnH (2.7 mL, 10 mmol) was added. The mixture was degassed by FTP (freeze thaw process) and heated to 100 °C. AIBN (0.82 g, 5.0 mmol) was added in portions over 7 h and the mixture was stirred over night at 100 °C. After cooling the solvent was removed in vacuo and the residue was purified by flash chromatography (140 g silica gel, pentane/MTBE 100:1 → 40:1) to yield disaccharide **20** (400 mg, 774 μmol, 70 % over 3 steps) as colorless oil. R_f=0.43 (*n*-hexane/MTBE 20:1); $[\alpha]_D^{20}$=−19.0 (*c*=1.03, $CHCl_3$); ^{1}H NMR (300 MHz, C_6D_6): δ=0.11, 0.19 (2 s, 6 H, $SiCH_3$), 0.62 (q, *J*=8.1 Hz, 6 H, $SiCH_2CH_3$), 0.99 (s, 9 H, $SiC(CH_3)_3$), 1.00 (t, *J*=7.7 Hz, 9 H, $SiCH_2CH_3$), 1.39 (d, *J*=5.7 Hz, 3 H, 6-H_3 olean.), 1.44 (s, 3 H, 3-CH_3 olivo.), 1.52–1.66 (m, 1 H, 2-H olean.), 1.60 (d, *J*=6.1 Hz, 3 H, 6-H_3 olivo.), 2.50 (ddd, *J*=12.3, 4.9, 1.8 Hz, 1 H, 2-H olean.), 3.03 (s, 3 H, OCH_3), 3.13 (ddd, *J*=11.5, 8.2, 5.0 Hz, 1 H, 3-H olean.), 3.28 (t, *J*=8.5, 1 H, 4-H olean.), 3.39 (dq, *J*=8.8, 6.1 Hz, 1 H, 5-H olean.), 3.87 (dq, *J*=10.3, 6.2 Hz, 1 H, 5-H olivo.), 4.14 (d, *J*=10.3 Hz, 1 H, 4-H olivo.), 4.63 (d, *J*=6.1 Hz, 1 H, 2-H olivo.), 5.15 (dd, *J*=10.0, 2.0 Hz, 1 H, 1-H olean.), 6.08 (d, *J*=5.9 Hz, 1 H, 1-H olivo.); ^{13}C NMR (75.5 MHz, C_6D_6): δ=−4.6, −3.6 ($SiCH_3$), 7.1, 7.3 ($SiCH_2CH_3$), 18.6 ($SiC(CH_3)_3$), 18.6, 18.8 (C-6 olivo., C-6 olean.), 26.3 ($SiC(CH_3)_3$), 26.8 (3-CH_3 olivo.), 36.3 (C-2 olean.), 55.6 (OCH_3), 73.0 (C-5 olean.), 74.0 (C-5 olivo.), 74.9 (C-3 olivo.), 77.4 (C-4 olean.), 81.6 (C-3 olean.), 82.8 (C-4 olivo.), 100.2 (C-1 olean.), 108.5 (C-2 olivo.), 143.1 (C-1 olivo.); IR (film): $\tilde{\nu}$=2957 (s), 2934 (s), 2879 (s), 2858 (s), 1646 (s), 1462 (s), 1388 (s), 1246 (s), 1230 (s), 1169 (s), 1102 (s), 1008 (s), 874 (s), 836 (s), 740 cm^{-1} (s); HR-MS (ESI): *m*/*z*: calcd for $C_{26}H_{52}O_6Si_2Na$: 539.3200; found 539.3184 $[M+Na]^+$.

Phenyl 2,3-*O*-isopropyliden-4-*O*-methyl-1-thio-α-L-rhamnopyranoside (22): Alcohol **21** (8.10 g, 27.3 mmol) was dissolved in DMF (30 mL) at 0 °C and powdered KOH (4.60 g, 82.0 mmol) was added. Then MeI (5.4 mL, 87 mmol) in DMF (15 mL) was added via cannula within 1 h. The bay-colored suspension was stirred for 2 h at 0 °C. The mixture was quenched with MeOH (30 mL). NH_4Cl (40 mL) was added and the aqueous layer was extracted with AcOEt (3×40 mL). The combined organic layers were washed subsequently with water (50 mL), brine (50 mL), dried with Na_2SO_4, concentrated and the residue was purified by flash chromatography (110 g silica gel, pentane/MTBE 10:1) to give methyl ether **22** (8.41 g, 27.1 mmol, 99 %) as a colorless oil. R_f=0.55 (*n*-hexane/MTBE 9:1); $[\alpha]_D^{22}$=−228.9 (*c*=5.16, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$): δ=1.23 (d, *J*=6.1 Hz, 3 H, 6-H_3), 1.37, 1.55 (2 s, 6 H, CH_3), 3.06 (dd, *J*=9.8, 7.1 Hz, 1 H, 4-H), 3.55 (s, 3 H, OCH_3), 4.05 (dq, *J*=9.9, 6.1 Hz, 1 H, 5-H), 4.19 (dd, *J*=6.8, 6.1 Hz, 1 H, 3-H), 4.33 (d, *J*=5.6 Hz, 1 H, 2-H), 5.72 (s, 1 H, 1-H), 7.25–7.35 (m, 3 H, Ph), 7.43–7.51 (m, 2 H, Ph); ^{13}C NMR (75 MHz, $CDCl_3$): δ=17.6 (C-6), 26.4, 28.0 (CH_3), 59.5 (OCH_3), 66.3 (C-5), 76.6 (C-2), 78.1 (C-3), 83.8 (C-4, C-1), 109.4 (C_q), 127.5, 129.0, 131.8 (CH, Ph), 134.0 (C_q, Ph); IR (film): $\tilde{\nu}$=3059 (m), 2986 (s), 2896 (s), 1480 (s), 1381 (s), 1220 (s), 1111 (s), 1071 (s), 808 (s), 751 cm^{-1} (s); elemental analysis calcd (%) for $C_{16}H_{22}O_4S$ (310.41): C 61.91, H 7.14; found C 61.87, H 7.23.

Phenyl 4-*O*-methyl-1-thio-α-L-rhamnopyranoside (23): Acetonide **22** (8.25 g, 26.6 mmol) was dissolved in DMF (50 mL) and *p*-TsOH (200 mg, 1.05 mmol) was added at 20 °C. The solution was stirred for 6 h. $NaHCO_3$ (20 mL) was added. The aqueous layer was extracted with AcOEt (3×30 mL), the combined organic layers were washed with brine (30 mL), dried with Na_2SO_4, and concentrated. The residue was recrystallized from AcOEt to yield diol **23** (6.40 g, 23.6 mmol, 89 %) as a colorless solid. M.p. 90 °C (AcOEt); R_f=0.45 ($CHCl_3$/MeOH 9:1); $[\alpha]_D^{21}$=−252.6 (*c*=6.38, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$): δ=1.32 (d, *J*=6.4 Hz, 3 H, 6-H_3), 3.18 (t, *J*=9.3 Hz, 1 H, 4-H), 3.38 (br s, 2 H, OH), 3.56 (s, 3 H, OCH_3), 3.88 (dd, *J*=9.3, 3.4 Hz, 1 H, 3-H), 4.12 (dq, *J*=9.3, 6.3 Hz, 1 H, 5-H), 4.18–4.25 (m, 1 H, 2-H), 5.47 (s, 1 H, 1-H), 7.20–7.34 (m, 3 H, Ph), 7.40–7.49 (m, 2 H, Ph); ^{13}C NMR (75 MHz, $CDCl_3$): δ=17.8 (C-6), 60.7 (OCH_3), 68.5 (C-5), 71.6 (C-3), 72.5 (C-2), 83.3 (C-4), 87.5 (C-1), 127.3, 129.0, 131.2 (CH, Ph), 134.1 (C_q, Ph); IR (film): $\tilde{\nu}$=3281 (br s), 2982 (m), 2834 (m), 1476 (m), 1164 (m), 1100 (s), 1057 (s), 840 (s), 742 cm^{-1} (s); HR-MS (EI): *m*/*z*: calcd for $C_{13}H_{18}O_4S$: 270.0926; found 270.0936 $[M]^+$.

Phenyl 3-*O*-*tert*-butyldimethylsilyl-4-*O*-methyl-1-thio-α-L-rhamnopyranoside (24): Diol **23** (300 mg, 1.11 mmol) was dissolved in CH_2Cl_2 (10 mL) at 0 °C. Imidazole (420 mg, 6.16 mmol), DMAP (38 mg, 0.31 mmol) TBSCl (1.86 g, 6.16 mmol, 50 % in toluene) were added. After stirring at 20 °C for 16 h the reaction was quenched by addition of NH_4Cl (20 mL). The aqueous layer was extracted with MTBE (3×25 mL). The combined organic layers were washed with brine (40 mL), dried with Na_2SO_4, concentrated and the residue was purified by flash chromatography (10 g silica gel, pentane/MTBE 10:1) to give monosilyl ether **24** (390 mg, 1.02 mmol, 91 %) as a colorless oil. R_f=0.21 (*n*-hexane/MTBE 9:1); $[\alpha]_D^{22}$=−183.9 (*c*=5.72, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$): δ=0.16, 0.19 (2 s, 6 H, $SiCH_3$), 0.95 (s, 9 H, $SiC(CH_3)_3$), 1.31 (d, *J*=6.4 Hz, 3 H, 6-H_3), 2.64–2.92 (br s, 1 H, OH), 3.10 (dd, *J*=9.2, 9.2 Hz, 1 H, 4-H), 3.52 (s, 3 H, OCH_3), 3.88 (dd, *J*=8.8, 3.4 Hz, 1 H, 3-H), 4.02 (dd, *J*=3.4, 1.2 Hz, 1 H, 2-H), 4.00–4.15 (m, 1 H, 5-H), 5.52 (s, 1 H, 1-H), 7.20–7.25 (m, 3 H, Ph), 7.42–7.51 (m, 2 H, Ph); ^{13}C NMR (75 MHz, $CDCl_3$): δ=−4.9, −4.7 ($SiCH_3$), 17.7 (C-6), 17.9 ($SiC(CH_3)_3$), 25.8 ($SiC(CH_3)_3$), 61.4 (OCH_3), 68.8 (C-5), 73.1 (C-3), 73.3 (C-2), 83.3 (C-4), 86.7 (C-1), 127.2, 129.0, 131.3 (CH, Ph), 134.2 (C_q, Ph); IR (film): $\tilde{\nu}$=3348 (br s), 2931 (s), 1441 (s), 1384 (s), 1255 (s), 1163 (s), 1071 (s), 840 (s), 742 cm^{-1} (s); HR-MS (ESI): *m*/*z*: calcd for $C_{19}H_{32}O_4SiSNH_4$: 402.2134; found 402.2117 $[M+NH_4]^+$.

Phenyl 3-*O*-*tert*-butyldimethylsilyl-4-*O*-methyl-2-oxo-1-thio-α-L-rhamnopyranoside (25): Alcohol **24** (1.73 g, 4.50 mmol) was dissolved in CH_2Cl_2 (60 mL) at 0 °C and Dess–Martin periodinane (3.8 g, 9.0 mmol) was added. The reaction mixture was stirred at 20 °C for 4 h. The reaction

was quenched with 50% satd aq $NaHCO_3$ (100 mL) and $Na_2S_2O_3$ (10 g). The aqueous layer was extracted with MTBE (3×50 mL). The combined organic layers were washed with brine (40 mL), dried with Na_2SO_4, concentrated and the residue was purified by flash chromatography (150 g silica gel, pentane/MTBE 20:1) to yield ketone **25** (1.38 g, 3.61 mmol, 80%) as a colorless oil. R_f=0.68 (*n*-hexane/MTBE 9:1); $[\alpha]_D^{20}=-256.8$ (c=8.15, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$): δ=0.08, 0.16 (2s, 6H, $SiCH_3$), 0.95 (s, 9H, $SiC(CH_3)_3$), 1.38 (d, J=6.4 Hz, 3H, 6-H_3), 3.06 (t, J=9.4 Hz, 1H, 4-H), 3.57 (s, 3H, OCH_3), 4.31–4.41 (m, 1H, 5-H), 4.38 (d, J=9.3 Hz, 1H, 3-H), 5.41 (s, 1H, 1-H), 7.26–7.35 (m, 3H, Ph), 7.41–7.52 (m, 2H, Ph); ^{13}C NMR (75 MHz, $CDCl_3$): δ=−5.5, −4.8 ($SiCH_3$), 17.4 (C-6), 18.5 ($SiC(CH_3)_3$), 25.7 ($SiC(CH_3)_3$), 61.4 (OCH_3), 69.5 (C-5), 79.3 (C-3), 87.9 (C-4), 90.1 (C-1), 128.3, 129.3, 132.5 (CH, Ph), 133.0 (C_q, Ph), 198.5 (C-2); IR (film): $\tilde{\nu}$=2934 (s), 2857 (s), 1690 (s), 1383 (s), 1254 (m), 1101 (s), 877 (s), 839 (s), 743 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{19}H_{30}O_4SSiNa$: 405.1532; found 405.1533 $[M+Na]^+$.

Phenyl 3-*O*-*tert*-butyldimethylsilyl-6-deoxy-4-*O*-methyl-1-thio-α-L-glucopyranoside (26): A solution of ketone **25** (1.32 g, 3.43 mmol) in MeOH (50 mL) was treated with $NaBH_4$ (0.16 g, 4.1 mmol) at 0°C. After 5 min the reaction was quenched with NH_4Cl (30 mL) at 0°C. Then the cooling bath was removed and stirring was allowed for 30 min at 20°C. The aqueous layer was extracted with AcOEt (3×50 mL), the combined organic layers were washed with brine (40 mL) and dried with Na_2SO_4. The solvents were evaporated and alcohol **26** (1.28 g, 3.33 mmol, 97%) obtained was used for the next step without further purification. R_f=0.15 (*n*-hexane/MTBE 9:1); $[\alpha]_D^{22}=-226.3$ (c=3.47, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$): δ=0.12, 0.13 (2s, 6H, $SiCH_3$), 0.94 (s, 9H, $SiC(CH_3)_3$), 1.27 (d, J=6.4 Hz, 3H, 6-H_3), 2.27–2.53 (brs, 1H, OH), 2.85 (t, J=9.0 Hz, 1H, 4-H), 3.60 (s, 3H, OCH_3), 3.77 (t, J=8.9 Hz, 1H, 3-H), 3.85 (dd, J=9.3, 5.4 Hz, 1H, 2-H), 4.07 (dq, J=9.6, 6.2 Hz, 1H, 5-H), 5.27 (d, J=5.1 Hz, 1H, 1-H), 7.19–7.34 (m, 3H, Ph), 7.40–7.49 (m, 2H, Ph); ^{13}C NMR (75 MHz, $CDCl_3$): δ=−4.7, −4.5 ($SiCH_3$), 17.7 (C-6), 18.1 ($SiC(CH_3)_3$), 25.7 ($SiC(CH_3)_3$), 60.5 (OCH_3), 67.4 (C-5), 73.8 (C-2), 75.0 (C-3), 84.9 (C-4), 88.8 (C-1), 127.0, 128.8, 131.8 (CH, Ph), 134.8 (C_q, Ph); IR (film): $\tilde{\nu}$=3481 (brs), 2930 (s), 2896 (s), 1254 (s), 1134 (s), 1083 (s), 839 (s), 739 cm^{-1} (s); elemental analysis calcd (%) for $C_{19}H_{32}O_4S$ (384.61): C 59.33, H 8.39; found C 59.21, H 8.58.

Phenyl 6-deoxy-4-*O*-methyl-1-thio-α-L-glucopyranoside (27): TBS ether **26** (1.28 g, 3.33 mmol) was dissolved in THF (60 mL) and cooled to 0°C. Then TBAF (1.1 g, 4.1 mmol) was added in portions. After 10 min the cooling bath was removed and the mixture was stirred for 3 h at 20°C. The reaction was quenched with phosphate buffer (1.0 M, pH 7, 50 mL) and MTBE (50 mL). The aqueous layer was extracted with MTBE (3×60 mL). The combined organic layers were washed with brine (60 mL), dried with Na_2SO_4, concentrated and the residue was purified by flash chromatography (150 g silica gel, $CHCl_3$/MeOH 20:1) to yield diol **27** (844 mg, 3.12 mmol, 94%) as a colorless solid. M.p. 90°C (CH_2Cl_2); R_f=0.44 ($CHCl_3$/MeOH 10:1); $[\alpha]_D^{22}=-29.1$ (c=0.18, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$): δ=1.32 (d, J=6.2 Hz, 3H, 6-H_3), 2.39 (d, J=8.0 Hz, 1H, 2-OH), 2.73 (d, J=1.6 Hz, 1H, 3-OH), 2.82 (t, J=9.2 Hz, 1H, 4-H), 3.58–3.64 (m, 4H, OCH_3, 3-H), 3.79–3.85 (m, 1H, 2-H), 4.17 (dq, J=9.6, 6.2 Hz, 1H, 5-H), 5.49 (d, J=5.3 Hz, 1H, 1-H), 7.25–7.31 (m, 3H, Ph), 7.45–7.49 (m, 2H, Ph); ^{13}C NMR (125 MHz, $CDCl_3$): δ=17.8 (C-6), 60.7 (OCH_3), 68.4 (C-5), 72.4 (C-2), 75.4 (C-3), 85.1 (C-4), 90.5 (C-1), 127.6, 129.1, 131.8 (CH, Ph), 134.3 (C_q, Ph); IR (film): $\tilde{\nu}$=3398 (brs), 2915 (s), 1126 (s), 1106 (s), 1080 (s), 740 cm^{-1} (s); HR-MS (EI): m/z: calcd for $C_{13}H_{18}O_4S$: 270.0926; found 270.0916 $[M]^+$.

1,4-Dichloro-1,1,4,4-tetraphenyl-1,4-disilabutane (29): 1,2-Bis(trichlorosilyl)ethane (**28**) (5.00 g, 16.8 mmol) was dissolved in THF (85 mL) at 0°C and phenylmagnesium bromide (24 mL, 3.0 M in Et_2O, 72 mmol) was added via dropping funnel within 45 min. The mixture was stirred for 20 h at 20°C. Subsequently THF was removed at 30°C at reduced pressure (0.1 mbar). The residue was taken up in pentane (100 mL, dest. from CaH_2) and the unsoluble magnesium salt was removed by filtration under argon. The solvent was evaporated again (see below), pentane (100 mL) was added and the salt was filtered again. Finally, pentane was distilled, the residue was dried in high vacuum for 3 h to yield product **29** (4.96 g, 10.7 mmol, 64%) as a colorless, storeable (argon) solid. M.p. 84°C (pentane); ^{1}H NMR (300 MHz, $CDCl_3$): δ=1.45 (s, 4H, $SiCH_2$), 7.32–7.51 (m, 12H, Ph), 7.55–7.69 (m, 8H, Ph); ^{13}C NMR (75 MHz, $CDCl_3$): δ=8.3 ($SiCH_2$), 128.2, 130.6 (CH, Ph), 132.9 (C_q, Ph), 134.4 (CH, Ph); IR (film): $\tilde{\nu}$=3069 (m), 3045 (m), 3011 (m), 1428 (m), 1137 (s), 1116 (s), 732 (s), 716 (s), 697 cm^{-1} (s); elemental analysis calcd (%) for $C_{26}H_{24}Cl_2Si_2$ (463.55): C 67.32, H 5.22; found C 67.59, H 5.35.

Phenyl 6-deoxy-4-*O*-methyl-2,3-*O*-(1,1,4,4-tetraphenyldisilabutandi-1,4-yl)-1-thio-α-L-glucopyranoside (30): Diol **27** (500 mg, 1.85 mmol) was dissolved in DMF (20 mL) and cooled to 0°C. Imidazole (6.43 g, 10.2 mmol) and $(ClSi(Ph)_2CH_2)_2$ **29** (1.20 g, 2.59 mmol) in DMF (7 mL) were added. After stirring at 0°C for 1 h the reaction was quenched by addition of NH_4Cl (35 mL) and MTBE (50 mL). The aqueous layer was extracted with MTBE (3×30 mL). The combined organic layers were washed with brine (20 mL), dried with $MgSO_4$, concentrated and the residue was purified by flash chromatography (40 g silica gel, pentane/MTBE 20:1) to yield bis(silyl ether) **30** (1.12 g, 1.69 mmol, 92%) as a colorless amorphous solid. M.p. 65°C (pentane); R_f=0.33 (*n*-hexane/MTBE 10:1); $[\alpha]_D^{24}=-6.6$ (c=1.0, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$): δ=0.98 (d, J=6.2 Hz, 3H, 6-H_3), 1.13–1.21 (m, 2H, $SiCH_2$), 1.34–1.46 (m, 2H, $SiCH_2$), 2.71 (t, J=9.2 Hz, 1H, 4-H), 3.28 (s, 3H, OCH_3), 3.76 (dd, J=9.2, 5.5 Hz, 1H, 2-H), 3.84 (t, J=8.9 Hz, 1H, 3-H), 3.90 (dq, J=9.7, 6.2 Hz, 1H, 5-H), 5.18 (d, J=5.5 Hz, 1H, 1-H), 6.99–7.69 (m, 25H, Ph); ^{13}C NMR (125 MHz, $CDCl_3$): δ=4.4, 5.7 ($SiCH_2$), 17.6 (C-6), 60.6 (OCH_3), 67.4 (C-5), 74.0 (C-2), 76.1 (C-3), 86.0 (C-4), 88.8 (C-1), 126.9, 127.78, 127.84, 127.88, 128.1, 128.8, 129.6, 129.8, 130.0, 130.2, 130.4, 131.9 (CH, Ph), 134.1, 134.2 (C_q, Ph), 134.4, 134.5, 134.7, 134.87 (CH, Ph), 134.91, 135.0 (C_q, Ph), 135.3 (CH, Ph), 136.3 (C_q, Ph); IR (film): $\tilde{\nu}$=3068 (m), 2916 (s), 1428 (m), 1119 (s), 1099 (s), 874 (m), 730 (s), 701 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{39}H_{40}O_4SSi_2K$: 699.1823; found 699.1823 $[M+K]^+$.

Phenyl 6-deoxy-4-*O*-methyl-2,3-*O*-(1,1,4,4-tetraphenyldisilabutandi-1,4-yl)-1-sulfinyl-α-L-glucopyranoside (31): Thioglycoside **30** (950 mg, 1.44 mmol) was dissolved in CH_2Cl_2 (60 mL) at −78°C and *m*CPBA (390 mg, 1.58 mmol, 70%) was added in portions. The reaction mixture was allowed to warm to −20°C within 2 h. The clear solution was quenched with $NaHCO_3$ (100 mL), water (20 mL) and $Na_2S_2O_3$ (5 g). The cooling bath was removed and the mixture was stirred for 20 min at 20°C. The aqueous layer was extracted with MTBE (3×40 mL). The combined organic layers were washed with brine (30 mL), dried with $MgSO_4$, concentrated and the residue was purified by flash chromatography (40 g silica gel, pentane/MTBE 3:1) to give sulfoxide **31** (896 mg, 1.32 mmol, 92%) as a colorless amorphous solid. M.p. > 80°C (decomp); R_f=0.19 (*n*-hexane/MTBE 2:1); $[\alpha]_D^{21}=+52.3$ (c=1.10, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$): δ=0.62 (d, J=6.2 Hz, 3H, 6-H_3), 1.31–1.45 (m, 2H, $SiCH_2$), 1.72–1.85 (m, 2H, $SiCH_2$), 2.48 (t, J=9.3 Hz, 1H, 4-H), 3.10 (dq, J=9.7, 6.0 Hz, 1H, 5-H), 3.23 (s, 3H, OCH_3), 4.30 (dd, J=9.1, 5.8 Hz, 1H, 2-H), 4.46 (t, J=9.1 Hz, 1H, 3-H), 4.49 (d, J=6.0 Hz, 1H, 1-H), 6.87–6.96 (m, 3H, Ph), 7.14–7.26 (m, 7H, Ph), 7.30–7.39 (m, 7H, Ph), 7.81–7.86 (m, 6H, Ph), 8.31–8.35 (m, 2H, Ph); ^{13}C NMR (125 MHz, $CDCl_3$): δ=4.0, 5.8 ($SiCH_2$), 17.2 (C-6), 60.8 (OCH_3), 72.8 (C-5), 75.3 (C-2), 77.7 (C-3), 85.0 (C-4), 100.8 (C-1), 126.6, 128.3, 128.4, 128.6, 129.9, 130.2, 130.5, 130.6, 130.9 (CH, Ph), 134.1, 134.2 (C_q, Ph), 134.4, 134.5, 134.7, 134.8 (CH, Ph), 134.3, 134.6, 135.3 (C_q, Ph), 134.9, 135.4, 135.7, 136.0 (CH, Ph), 137.2, 143.3 (C_q, Ph); IR (film): $\tilde{\nu}$=3070 (s), 2976 (s), 2934 (s), 2881 (s), 1428 (s), 1175 (s), 1120 (s), 846 (s), 700 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{39}H_{40}O_5SSi_2H$: 677.2213; found 677.2224 $[M+H]^+$.

(2*E*,4*E*,8*E*,6*R*,7*S*)-7-*tert*-Butylsilyloxy-1-hydroxy-9-iodo-2,4,6-trimethylnona-2,4,8-triene (35): Ester **34** (571 mg, 1.19 mmol) was dissolved in toluene (17 mL) at −78°C and DIBAH (2.6 mL, 2.6 mmol, 1.0 M in PE) was added dropwise. After stirring for 30 min at −78°C, the reaction was quenched by addition via cannula to a cooled (0°C) solution of Rochelles salt (50 mL, 1.0 M). After stirring for 1 h, the two layers were separated and the aqueous layer was extracted with MTBE (3×40 mL). The combined organic layers were washed with brine (30 mL), dried with $MgSO_4$, concentrated and the residue was purified by flash chromatography (60 g silica gel, pentane/MTBE 6:1→4:1) to give alcohol **35** (510 mg, 1.17 mmol, 98%) as a colorless oil. R_f=0.44 ($CHCl_3$/MeOH 100:1); $[\alpha]_D^{23}=-22.9$ (c=0.19, $CHCl_3$); ^{1}H NMR (200 MHz, $CDCl_3$): δ=−0.01,

0.02 (2s, 6H, $SiCH_3$), 0.87 (s, 9H, $SiC(CH_3)_3$), 0.96 (d, $J=6.8$ Hz, 3H, 6-CH_3), 1.71 (d, $J=1.0$ Hz, 3H, 4-CH_3), 1.77 (d, $J=1.0$ Hz, 3H, 2-CH_3), 2.41–2.61 (m, 1H, 6-H), 3.84 (t, $J=6.5$ Hz, 1H, 7-H), 4.03 (brs, 2H, 2-H_2), 5.06 (d, $J=9.8$ Hz, 1H, 5-H), 5.84 (s, 1H, 3-H), 6.15 (dd, $J=14.3$, 1.0 Hz, 1H, 9-H), 6.51 (dd, $J=14.4$, 6.4 Hz, 1H, 8-H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=-4.9$, -4.4 ($SiCH_3$), 15.4 (2-CH_3), 16.7 (4-CH_3), 17.3 (6-CH_3), 18.2 ($SiC(CH_3)_3$), 25.8 ($SiC(CH_3)_3$), 39.6 (C-6), 69.3 (C-1), 76.3 (C-7), 79.2 (C-9), 129.3 (C-3), 131.7 (C-5), 133.1 (C-2), 134.7 (C-4), 148.0 (C-8); IR (film): $\tilde{\nu}=3332$ (brs), 2957 (s), 2929 (s), 2858 (s), 1463 (s), 1361 (s), 1257 (s), 1165 (s), 1068 (s), 1006 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{18}H_{33}IO_2SiNa$: 459.1192; found 459.1198 $[M+Na]^+$.

(2*E*,4*E*,8*E*,6*R*,7*S*)-1-Acetoxy-7-hydroxy-9-iodo-2,4,6-trimethyl-2,4,8-nonatriene (36): NEt_3 (500 μL, 4.10 mmol), Ac_2O (320 μL, 3.51 mmol) and DMAP (7 mg, 6 μmol) were added to a solution of allylic alcohol **35** (510 mg, 1.17 mmol) in CH_2Cl_2 (13 mL) at 0 °C. After stirring for 1 h at 0 °C, the reaction was quenched by addition of NH_4Cl (3 mL) and H_2O (5 mL). The two layers were separated and the aqueous layer was extracted with MTBE (1×40 mL and 3×15 mL). The combined organic layers were washed with brine (20 mL), dried with $MgSO_4$, concentrated and the residue so obtained was used for the next step without purification. The crude product from the acetate protection was dissolved in THF (22 mL) and cooled to 0 °C. Then TBAF (1.11 g, 3.51 mmol) was added. After 10 min the cool bath was removed and the mixture was stirred for 2 h at 20 °C. The reaction was quenched with NH_4Cl (10 mL) and the aqueous layer was extracted with MTBE (3×30 mL). The combined organic layers were washed with brine (20 mL), dried with $MgSO_4$, concentrated and the residue was purified by flash chromatography (40 g silica gel, pentane/MTBE 3:1) to yield glycosyl acceptor **36** (393 mg, 1.08 mmol, 92% for 2 steps) as a colorless oil. $R_f=0.44$ ($CHCl_3$/MeOH 100:1); $[\alpha]_D^{20}=+41.7$ ($c=1.15$, $CHCl_3$); ^{1}H NMR (200 MHz, $CDCl_3$): $\delta=$ 0.86 (d, $J=6.8$ Hz, 3H, 6-CH_3), 1.04–1.07 (brs, 1H, OH), 1.54 (d, $J=$ 1.1 Hz, 3H, 4-CH_3), 1.68 (2×s, 6H, 2-CH_3, OAc), 2.26–2.38 (m, 1H, 6-H), 3.41–3.46 (m, 1H, 7-H), 4.46 (s, 2H, 1-H_2), 5.04 (d, $J=10.0$ Hz, 1H, 5-H), 5.82 (s, 1H, 3-H), 5.99 (dd, $J=14.4$, 1.1 Hz, 1H, 9-H), 6.39 (dd, $J=$ 14.4, 5.9 Hz, 1H, 8-H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=15.7$ (2-CH_3), 16.3 (6-CH_3), 17.1 (4-CH_3), 20.4 (OAc), 38.8 (C-6), 70.3 (C-1), 77.4 (C-9), 78.1 (C-7), 130.6 (C-4), 132.0 (C-5), 132.3 (C-3), 133.2 (C-2), 147.7 (C-8), 170.0 (OAc); IR (film): $\tilde{\nu}=3448$ (brs), 2924 (s), 2854 (s), 1753 (s), 1456 (s), 1377 (s), 1233 (s), 1167 (s), 1022 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{14}H_{21}IO_3K$: 403.0173; found 403.0175 $[M+K]^+$.

(2*E*,4*E*,8*E*,6*R*,7*S*)-1-Acetoxy-7-[6-deoxy-4-*O*-methyl-2,3-*O*-(1,1,4,4-tetraphenyldisilabutandi-1,4-yl)-α-L-glucopyranosyl]-9-iodo-2,4,6-trimethyl-2,4,8-nonatriene (37): Glycosyldonor **31** (782 mg, 1.16 mmol) and 2,6-*tert*-butyl-4-methyl pyridine (395 mg, 1.92 mmol) were combined and azeotroped with toluene (3×10 mL). After drying under high vacuum for 1 h, the mixture was dissolved in Et_2O (30 mL), 4 Å MS (powder; 1 g) was added and the suspension was stirred for 1 h at 20 °C. The mixture was cooled to −80 °C and Tf_2O (0.19 mL, 1.1 mmol) was added via glass syringe within 3 min. After 10 min stirring glycosyl acceptor **36** (275 mg, 755 μmol), dissolved in Et_2O (10 mL), was added dropwise within 10 min at −80 °C. The mixture was allowed to warm to −35 °C within 2 h and was then quenched with NEt_3 (350 μL). The cooling bath was removed, $NaHCO_3$ was added and the aqueous layer was extracted with MTBE (3×50 mL). The combined organic layers were washed with brine (50 mL), dried with $MgSO_4$, concentrated and the residue was purified by flash chromatography (100 g silica gel, pentane/MTBE 10:1) to yield the colorless, oily glycosylated products **37a**/**37b** (452 mg, 494 μmol, 65%) as an anomeric mixture (85:15, ^{1}H NMR). The anomers could be separated by repeated chromatography with neutral silica gel (toluene/cyclohexane/CH_2Cl_2/AcOEt 40:40:20:1). α-anomer **37a**: $R_f=0.19$ (cyclohexane/toluene/CH_2Cl_2/AcOEt 10:10:5:1); $[\alpha]_D^{22}=+48.3$ ($c=0.85$, MTBE); ^{1}H NMR (500 MHz, C_6D_6): $\delta=0.84$ (d, $J=6.8$ Hz, 3H, 6-CH_3), 1.21 (d, $J=6.2$ Hz, 3H, 6-H_3 gluco), 1.25–1.36 (m, 2H, $SiCH_2$), 1.47 (d, $J=0.9$ Hz, 3H, 4-CH_3), 1.67 (d, $J=1.2$ Hz, 3H, 2-CH_3), 1.70 (s, 3H, OAc), 1.65–1.73 (m, 2H, $SiCH_2$), 2.48–2.59 (m, 1H, 6-H), 2.70 (t, $J=9.2$ Hz, 1H, 4-H gluco), 3.32 (s, 3H, OCH_3), 3.73 (dd, $J=7.6$, 6.7 Hz, 1H, 7-H), 3.81–3.87 (m, 2H, 2-H, 5-H gluco), 4.38 (t, $J=9.4$ Hz, 1H, 3-H gluco), 4.48 (s, 2,H, 1-H_2), 4.80 (d, $J=3.9$ Hz, 1H, 1-H gluco), 4.99 (d, $J=9.8$ Hz, 1H, 5-H), 5.82 (s, 1H, 3-H), 6.04 (dd, $J=14.6$, 1.1 Hz, 1H, 9-H), 6.50 (dd, $J=14.6$, 8.1 Hz, 1H, 8-H), 7.16–7.33 (m, 10H, Ph), 7.39 (t, $J=7.7$ Hz, 2H, Ph), 7.69–7.73 (m, 2H, Ph), 7.79–7.86 (m, 6H, Ph); ^{13}C NMR (125 MHz, C_6D_6): $\delta=4.7$, 6.1 ($SiCH_2$), 15.9 (2-CH_3), 17.19, 17.24 (6-CH_3, 4-CH_3), 18.0 (C-6 gluco), 20.5 (OAc), 37.4(C-6), 60.7 (OCH_3), 67.5 (C-5 gluco), 70.3 (C-1), 74.6 (C-2 gluco), 75.9 (C-3 gluco), 80.5 (C-9), 82.4 (C-7), 86.7 (C-4 gluco), 95.8 (C-1 gluco), 128.1, 128.3, 128.4, 128.5, 129.8, 130.1, 130.3, 130.63 (CH, Ph), 130.58 (C-2 o. C-4), 131.6 (C-5), 132.4 (C-3), 133.5 (C-2 o. C-4), 134.6 (C_q, Ph), 134.85, 134.91 (CH, Ph), 135.0 (C_q, Ph), 135.4, 135.74 (CH, Ph), 135.81, 137.4 (C_q, Ph), 144.6 (C-8), 169.9 (OAc); IR (film): $\tilde{\nu}=3069$ (s), 3050 (s), 2916 (s), 2868 (s), 1738 (s), 1377 (s), 1228 (s), 1110 (s), 1030 (s), 700 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{47}H_{55}IO_7Si_2NH_4$: 932.2875; found 932.2837 $[M+NH_4]^+$; β-anomer **37b**: $R_f=0.21$ (cyclohexane/toluene/CH_2Cl_2/AcOEt 10:10:5:1); ^{1}H NMR (500 MHz, C_6H_6): $\delta=0.90$ (d, $J=6.8$ Hz, 3H, 6-CH_3), 1.13 (d, $J=6.1$ Hz, 3H, 6-H_3 gluco), 1.31–1.37 (m, 2H, $SiCH_2$), 1.46 (d, $J=1.0$ Hz, 3H, 4-CH_3), 1.69 (2s, 6H, OAc, 2-CH_3), 1.67–1.73 (m, 2H, $SiCH_2$), 2.47–2.55 (m, 1H, 6-H), 2.56 (dd, $J=9.2$, 8.8 Hz, 1H, 4-H gluco), 2.96 (dq, $J=9.5$, 6.1 Hz, 1H, 5-H gluco), 3.19 (s, 3H, OCH_3), 3.59 (dd, $J=6.8$, 6.3 Hz, 1H, 7-H), 3.84 (dd, $J=8.7$, 7.5 Hz, 1H, 2-H gluco), 3.90 (dd, $J=8.3$, 8.3 Hz, 1H, 3-H gluco), 4.11 (d, $J=7.5$ Hz, 1H, 1-H gluco), 4.45 (s, 2,H, 1-H_2), 5.14 (d, $J=9.6$ Hz, 1H, 5-H), 5.78 (s, 1H, 3-H), 5.93 (dd, $J=14.3$, 1.0 Hz, 1H, 9-H), 6.56 (dd, $J=14.3$, 6.7 Hz, 1H, 8-H), 7.18–7.32 (m, 12H, Ph), 7.76–7.88 (m, 8H, Ph); ^{13}C NMR (75.5 MHz, C_6D_6): $\delta=6.4$, 6.6 ($SiCH_2$), 15.8 (2-CH_3), 17.0, 17.2 (6-CH_3, 4-CH_3), 17.9 (C-6 gluco), 20.5 (OAc), 38.1 (C-6), 60.8 (OCH_3), 70.4 (C-1), 71.2 (C-5 gluco), 76.4 (C-2 gluco), 77.6 (C-9), 79.2 (C-3 gluco), 86.0 (C-7, C-4 gluco), 102.6 (C-1 gluco), 128.1, 128.2, 129.9, 130.0, 130.45 (CH, Ph), 130.48 (C-2 or C-4), 130.52 (CH, Ph), 132.0 (C-5), 132.5 (C-3), 132.8 (C-2 or C-4), 134.3, 134.5 (C_q, Ph), 134.9, 135.0, 136.0, 136.2, (CH, Ph), 136.6, 137.0 (C_q, Ph), 146.5 (C-8), 169.9 (OAc).

(2*E*,4*E*,8*E*,6*R*,7*S*)-7-[6-Deoxy-4-*O*-methyl-2,3-*O*-(1,1,4,4-tetraphenyldisilabutan-1,4-diyl)-α-L-glucopyranosyl]-1-hydroxy-9-iodo-2,4,6-trimethyl-2,4,8-nonatriene (38): *Via KCN in MeOH:* Acetate **37a** (166 mg, 181 μmol) was dissolved in MeOH/CH_2Cl_2 (7:1, 8 mL). KCN (5.5 mg, 84 μmol) was added and the mixture was heated to 40 °C for 3 h. After cooling to 20 °C, phosphate buffer (10 mL, 1.0 M, pH 7) was added and the aqueous layer was extracted with MTBE (3×50 mL). The combined organic layers were washed with brine (30 mL), dried with $MgSO_4$, concentrated and the residue was purified by flash chromatography (20 g silica gel, pentane/MTBE 7:2) to give starting material **37a** (63 mg, 69 μmol, 38%) and alcohol **38** (84 mg, 96 μmol, 53%) as a colorless oil. *Via $LiEt_3BH$:* Acetate **37a** (63 mg, 69 μmol) was dissolved in THF (4 mL) and cooled to −78 °C. $LiEt_3BH$ (0.50 mL, 1.0 M in THF, 0.50 mmol) was slowly added and the mixture was allowed to warm to −50 °C within 1 h. The reaction was quenched by addition of phosphate buffer (1 M, pH 7, 4 mL), the aqueous layer was extracted with MTBE (3×10 mL) and dried with $MgSO_4$. The solvents were removed and the residue was purified by flash chromatography (7 g silica gel, pentane/MTBE 4:1) to afford alcohol **38** (45 mg, 52 μmol, 75%). $R_f=0.31$ (toluene/cyclohexane/CH_2Cl_2/AcOEt 10:5:5:1); $[\alpha]_D^{24}=+42.9$ ($c=0.70$, $CHCl_3$); ^{1}H NMR (400 MHz, C_6D_6): $\delta=0.90$ (d, $J=6.6$ Hz, 3H, 6-CH_3), 1.20 (d, $J=6.2$ Hz, 3H, 6-H_3 gluco), 1.26–1.36 (m, 2H, $SiCH_2$), 1.54 (d, $J=1.1$ Hz, 3H, 4-CH_3), 1.66 (d, $J=0.9$ Hz, 3H, 2-CH_3), 1.62–1.78 (m, 2H, $SiCH_2$), 2.48–2.59 (m, 1H, 6-H), 2.70 (t, $J=9.2$ Hz, 1H, 4-H gluco), 3.32 (s, 3H, OCH_3), 3.73 (dd, $J=7.6$, 6.7 Hz, 1H, 7-H), 3.81–3.87 (m, 2H, 2-H, 5-H gluco), 4.38 (dd, $J=9.4$, 9.4 Hz, 1H, 3-H gluco), 4.48 (s, 2,H, 1-H_2), 4.80 (d, $J=3.9$ Hz, 1H, 1-H gluco), 4.99 (d, $J=9.8$ Hz, 1H, 5-H), 5.82 (s, 1H, 3-H), 6.04 (dd, $J=14.6$, 1.1 Hz, 1H, 9-H), 6.50 (dd, $J=14.6$, 8.1 Hz, 1H, 8-H), 7.16–7.33 (m, 10H, Ph), 7.39 (t, $J=7.7$ Hz, 2H, Ph), 7.69–7.73 (m, 2H, Ph), 7.79–7.86 (m, 6H, Ph); ^{13}C NMR (100.6 MHz, $CDCl_3$): $\delta=$ 4.7, 6.1 ($SiCH_2$), 15.6 (2-CH_3), 17.2, 17.5 (4-CH_3, 6-CH_3), 18.0 (C-6 gluco), 37.4 (C-6), 60.7 (OCH_3), 67.5, 69.0 (C-1, C-5 gluco), 74.6 (C-2 gluco), 75.9 (C-3 gluco), 80.4 (C-9), 82.4 (C-7), 86.7 (C-4 gluco), 95.7 (C-1 gluco), 128.1, 128.4, 128.5 (CH, Ph), 128.8 (C-3), 129.8, 130.1, 130.3, 130.6 (CH, Ph), 131.5 (C-5), 133.4, 134.6 (C-2 or C-4 or CH, Ph), 134.86, 134.92, 135.4 (CH, Ph), 135.5 (C_q, Ph), 135.7 (CH, Ph), 135.8, 137.4 (C_q, Ph), 144.6 (C-8); IR (film): $\tilde{\nu}=3448$ (brs), 3068 (s), 2973 (s), 2928 (s), 2874 (s), 1428 (s), 1170 (s), 1074 (s), 861 (s), 700 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{45}H_{53}IO_6Si_2NH_4$: 890.2769; found 890.2755 $[M+NH_4]^+$.

(2*E*,4*E*,6*E*,10*E*,8*R*,9*S*)-Methyl 9-[6-deoxy-4-*O*-methyl-2,3-*O*-(1,1,4,4-tetraphenyldisilabutandi-1,4-yl)-α-L-glucopyranosyl]-11-iodo-2,4,6,8-tetramethylundecatetra-2,4,6,10-enoate (39): Allylic alcohol **38** (84 mg, 96 μmol) was dissolved in CH_2Cl_2 (8 mL), MnO_2 (590 mg, 6.79 mmol) was added and the mixture was stirred for 30 min at 20 °C. The mixture was filtered over a pad of Celite and the residue was washed with CH_2Cl_2 (100 mL). The solvent was removed and the aldehyde obtained was used for the next step without purification. The crude aldehyde was azeotroped with toluene (3×5 mL) and dissolved in toluene (5 mL). $Ph_3PC(CH_3)CO_2Me$ (0.20 g, 0.58 mmol) was added and the mixture was heated to 90 °C and stirred for 44 h. After cooling to 20 °C the solvent was removed, the residue was taken up in cyclohexane/CH_2Cl_2 10:1 (1 mL) and purified by flash chromatography (10 g neutral silica gel, pentane/MTBE 12:1) to yield methyl ester **39** (82 mg, 87 μmol, 91 %, 2 steps) as a colorless oil. R_f=0.53 (*n*-hexane/MTBE 2:1); $[\alpha]_D^{29}$=+95.1 (*c*=1.48, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ=0.84 (d, *J*=6.7 Hz, 3H, 8-CH_3), 1.20 (d, *J*=6.2 Hz, 3H, 6-H_3 gluco), 1.25–1.38 (m, 2H, $SiCH_2$), 1.46 (s, 3H, 6-CH_3), 1.61–1.76 (m, 2H, 2-H $SiCH_2$), 1.79 (s, 3H, 4-CH_3), 2.10 (d, *J*=0.7 Hz, 3H, 2-CH_3), 2.49–2.59 (m, 1H, 8-H), 2.69 (dd, *J*=9.1, 9.1 Hz, 1H, 4-H gluco), 3.31 (s, 3H, OCH_3), 3.48 (s, 3H, CO_2CH_3), 3.75 (dd, *J*=7.4, 6.7 Hz, 1H, 9-H), 3.79–3.87 (m, 1H, 5-H gluco), 3.84 (dd, *J*=9.3, 3.4 Hz, 1H, 2-H gluco), 4.38 (t, *J*=9.0 Hz, 1H, 3-H gluco), 4.80 (d, *J*=3.8 Hz, 1H, 1-H gluco), 5.05 (d, *J*=9.8 Hz, 1H, 7-H), 5.91 (s, 1H, 5-H), 6.05 (d, *J*=14.5 Hz, 1H, 11-H), 6.50 (dd, *J*=14.6, 8.0 Hz, 1H, 10-H), 7.17–7.34 (m, 10H, Ph), 7.38 (t, *J*=7.3 Hz, 2H, Ph.), 7.44 (s, 1H, 3-H), 7.71 (d, *J*=6.7 Hz, 2H, Ph), 7.76–7.88 (m, 2H, Ph); ^{13}C NMR (125 MHz, $CDCl_3$): δ=4.6, 6.1 ($SiCH_2$), 14.5 (2-CH_3), 16.9, 17.3 (6-CH_3, 8-CH_3), 18.0 (C-6 gluco), 18.6 (4-CH_3), 37.5 (C-8), 51.4 (CO_2CH_3), 60.8 (OCH_3), 67.6 (C-5 gluco), 74.6 (C-2 gluco), 75.9 (C-3 gluco), 80.6 (C-11), 82.2 (C-9), 86.7 (C-4 gluco), 95.8 (C-1 gluco), 126.2 (C-2), 128.1, 128.2, 128.4, 128.5, 129.8, 130.1, 130.3, 130.6 (CH, Ph), 132.5 (C-4), 132.9 (C-7), 133.6 (C-6), 134.6 (C_q, Ph), 134.8, 134.89 (CH, Ph), 134.93 (C_q, Ph), 135.4, 135.7 (CH, Ph), 137.4 (C_q, Ph), 139.1 (C-5), 144.0 (C-3), 144.4 (C-10), 169.1 (C-1); IR (film): $\tilde{\nu}$=3069 (s), 2977 (s), 2927 (s), 2875 (s), 1707 (s), 1429 (s), 1254 (s), 1118 (s), 1028 (s), 859 (s), 700 cm^{-1} (s); HR-MS (ESI): *m*/*z*: calcd for $C_{49}H_{57}IO_7Si_2Na$: 963.2585; found 963.2591 $[M+Na]^+$.

(2*E*,4*E*,8*E*,6*R*,7*S*)-1-Acetoxy-7-[6-deoxy-4-*O*-methyl-2,3-*O*-di(triethylsilyl)-α,β-L-glucopyranosyl]-9-iodo-2,4,6-trimethylnona-2,4,8-triene (40): The α,β-mixture of SIBA-ethers **37a**/**37b** (420 mg, 460 μmol) was dissolved in THF (20 mL) and cooled to 0 °C. Then TBAF (305 mg, 966 μmol) was added. After 10 min the cooling bath was removed and the mixture was stirred for 1 h at 20 °C. The reaction was quenched with phosphate buffer (20 mL, 1.0 M, pH 7) and the aqueous layer was extracted with MTBE (3×15 mL). The combined organic layers were washed with brine (20 mL), dried with $MgSO_4$, concentrated and the residue was purified by flash chromatography (40 g silica gel, pentane/MTBE 1:3) to yield the corresponding diol (240 mg, 450 μmol, 99 %) as a colorless oil. The diol (240 mg, 450 μmol) was dissolved in CH_2Cl_2 (20 mL) and cooled to 0 °C. Imidazole (312 mg, 4.50 mmol) and TESCl (0.48 mL, 2.7 mmol) were added, the cooling bath was removed and the mixture was stirred for 30 min at 20 °C. The reaction was quenched with phosphate buffer solution (20 mL, 1.0 M, pH 7) and the aqueous layer was extracted with MTBE (3×20 mL). The combined organic layers were washed with brine (30 mL), dried with $MgSO_4$ and the solvent was evaporated. The crude product was purified by flash chromatography (40 g silica gel, pentane/MTBE 5:2) to give bis(silyl ether) **40** (336 mg, 446 μmol, 99 %) as a colorless oil. An analytical sample of anomeric mixture was separated by chromatography (*n*-hexane/MTBE 4:1). Data of α-anomer: R_f=0.40 (*n*-hexane/MTBE 4:1); $[\alpha]_D^{20}$=−34.3 (*c*=0.89, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ=0.72 (q, *J*=7.7 Hz, 6H, $SiCH_2CH_3$), 0.85 (q, *J*=7.5 Hz, 6H, $SiCH_2CH_3$), 0.97 (d, *J*=6.9 Hz, 3H, 6-CH_3), 1.09 (t, *J*=7.9 Hz, 9H, $SiCH_2CH_3$), 1.14 (t, *J*=7.9 Hz, 9H, $SiCH_2CH_3$), 1.31 (d, *J*=6.4 Hz, 3H, 6-H_3 gluco), 1.56 (s, 3H, 4-CH_3), 1.70 (s, 3H, OAc), 1.74 (s, 3H, 2-CH_3), 2.55–2.63 (m, 1H, 6-H), 2.64 (dd, *J*=9.1, 9.1 Hz, 1H, 4-H gluco), 3.33 (s, 3H, OCH_3), 3.64 (dd, *J*=9.4, 3.4 Hz, 1H, 2-H gluco), 3.77 (t, *J*=7.9 Hz, 1H, 7-H), 3.81–3.91 (m, 1H, 5-H gluco), 4.12 (t, *J*=9.1 Hz, 1H, 3-H gluco), 4.47 (s, 2,H, 1-H_2), 4.82 (d, *J*=3.2 Hz, 1H, 1-H gluco), 5.06 (d, *J*=9.6 Hz, 1H, 5-H), 5.83 (s, 1H, 3-H), 6.09 (d, *J*=14.4 Hz, 1H, 9-H), 6.42 (dd, *J*=14.6, 8.1 Hz, 1H, 8-H); ^{13}C NMR (125 MHz, $CDCl_3$): δ=5.6, 5.8 ($SiCH_2CH_3$), 7.36, 7.39 ($SiCH_2CH_3$), 15.9 (2-CH_3), 17.1, 17.2 (6-CH_3, 4-CH_3), 18.6 (C-6 gluco), 20.4 (OAc), 37.6 (C-6), 61.0 (OCH_3), 68.2 (C-5 gluco), 70.3 (C-1), 74.4, 74.6 (C-2 gluco, C-3 gluco), 81.0 (C-9), 81.8 (C-7), 87.7 (C-4 gluco), 96.3 (C-1 gluco), 130.7, 133.1 (C-2, C-4), 131.7 (C-5), 132.3 (C-3), 144.7 (C-8), 169.8 (OAc); IR (film): $\tilde{\nu}$=3020 (w), 2958 (s), 2916 (s), 2878 (s), 1730 (s), 1423 (s), 1384 (s), 1216 (s), 1140 (s), 1073 (s), 1020 (s), 982 (s), 848 cm^{-1} (s); HR-MS (ESI): *m*/*z*: calcd for $C_{33}H_{61}IO_7Si_2NH_4$: 770.3344; found 770.3340 $[M+NH_4]^+$.

(2*E*,4*E*,8*E*,6*R*,7*S*)-7-[6-Deoxy-4-*O*-methyl-2,3-*O*-bis(triethylsilyl)-α-L-glucopyranosyl]-9-iodo-2,4,6-trimethylnona-2,4,8-trienal (41) and (2*E*,4*E*,8*E*,6*R*,7*S*)-7-[6-deoxy-4-*O*-methyl-2,3-*O*-bis(triethylsilyl)-β-L-glucopyranosyl]-9-iodo-2,4,6-trimethylnona-2,4,8-trienal (42): Acetate **40** (336 mg, 446 μmol) was dissolved in THF/MeOH/H_2O (12 mL, 2:1:1) and cooled to 0 °C. LiOH·H_2O (56 mg, 1.3 mmol) was added and the mixture was stirred for 1 h at 0 °C. The reaction was quenched by addition of NH_4Cl (10 mL) and the aqueous layer was extracted with MTBE (3× 15 mL). The combined organic layers were washed with brine (30 mL), dried with $MgSO_4$ and concentrated to give the crude alcohol (263 mg, 370 μmol, 83 %) which was used without further purification for the next reaction. The crude mixture of anomeric allylic alcohols (263 mg, 370 μmol) thus obtained was dissolved in CH_2Cl_2 (20 mL). MnO_2 (1.3 g, 15.0 mmol) was added and the mixture was stirred at 20 °C. After 30 min the mixture was filtered over a pad of celite and the residue was washed with CH_2Cl_2 (60 mL). The solvent was removed and the residue was purified by flash chromatography (45 g silica gel, pentane/MTBE 15:1→9:1) to yield (34 mg, 48 μmol, 13 %) β-anomer **42** and (203 mg, 290 μmol, 78 %) α-anomer **41** as colorless liquids. The aldehydes were used for the next reaction within 24 h and they were stored in a cyclohexane matrix at −28 °C. α-anomer **41**: R_f=0.51 (*n*-hexane/MTBE 3:1); $[\alpha]_D^{21}$=−55.5 (*c*=0.85, $CHCl_3$); ^{1}H NMR (400 MHz, C_6D_6): δ=0.70 (q, *J*=7.9 Hz, 6H, $SiCH_2CH_3$), 0.84 (q, *J*=8.0 Hz, 6H, $SiCH_2CH_3$), 0.89 (d, *J*=6.8 Hz, 3H, 6-CH_3), 1.07 (t, *J*=7.9 Hz, 9H, $SiCH_2CH_3$), 1.13 (t, *J*=7.9 Hz, 9H, $SiCH_2CH_3$), 1.29 (d, *J*=6.4 Hz, 3H, 6-H_3 gluco), 1.59 (d, *J*=1.2 Hz, 3H, 4-CH_3), 1.91 (d, *J*=0.9 Hz, 3H, 2-CH_3), 2.50–2.60 (m, 1H, 6-H), 2.62 (dd, *J*=9.2, 9.2 Hz, 1H, 4-H gluco), 3.31 (s, 3H, OCH_3), 3.62 (dd, *J*=9.3, 3.4 Hz, 1H, 2-H gluco), 3.73–3.84 (m, 2H, 7-H, 5-H gluco), 4.07 (t, *J*=9.0 Hz, 1H, 3-H gluco), 4.78 (d, *J*=3.5 Hz, 1H, 1-H gluco), 5.30 (d, *J*=9.9 Hz, 1H, 5-H), 6.11 (d, *J*=14.6 Hz, 1H, 9-H), 6.23 (brs, 1H, 3-H), 6.36 (dd, *J*=14.4, 8.2 Hz, 1H, 8-H), 9.30 (s, 1H, 1-H); ^{13}C NMR (100.6 MHz, C_6D_6): δ=5.6, 5.8 ($SiCH_2CH_3$), 7.3, 7.4 ($SiCH_2CH_3$), 10.9 (2-CH_3), 16.4 (2×C, 6-CH_3, 4-CH_3), 18.5 (C-6 gluco), 37.6 (C-6), 61.1 (OCH_3), 68.4 (C-5 gluco), 74.4, 74.5 (C-2 gluco, C-3 gluco), 81.4, 81.5 (C-7, C-9), 87.6 (C-4 gluco), 96.3 (C-1 gluco), 133.8, 136.8 (C-2, C-4), 139.5 (C-5), 144.0 (C-8), 153.0 (C-3), 194.7 (C-1); IR (film): $\tilde{\nu}$=2957 (s), 2913 (s), 2875 (s), 2831 (s), 1680 (s), 1607 (s), 1459 (s), 1380 (s), 1239 (s), 1140 (s), 1038 cm^{-1} (s).

β-anomer **42**: R_f=0.58 (*n*-hexane/MTBE 3:1); $[\alpha]_D^{21}$=+2.7 (*c*=1.00, $CHCl_3$); ^{1}H NMR (400 MHz, C_6D_6): δ=0.79–0.94 (m, 12H, $SiCH_2CH_3$), 0.91 (d, *J*=6.9 Hz, 3H, 6-CH_3), 1.07–1.16 (m, 18H, $SiCH_2CH_3$), 1.23 (d, *J*=6.1 Hz, 3H, 6-H_3 gluco), 1.65 (d, *J*=1.3 Hz, 3H, 4-CH_3), 1.88 (d, *J*=1.1 Hz, 3H, 2-CH_3), 2.58 (dd, *J*=8.7, 8.7 Hz, 1H, 4-H gluco), 2.72–2.83 (m, 1H, 6-H), 3.10 (dq, *J*=9.4, 6.2 Hz, 1H, 5-H gluco), 3.16 (s, 3H, OCH_3), 3.53 (t, *J*=8.0 Hz, 1H, 2-H gluco), 3.57 (t, *J*=8.3 Hz, 1H, 3-H gluco), 3.69 (t, *J*=7.0 Hz, 1H, 7-H), 4.09 (d, *J*=7.2 Hz, 1H, 1-H gluco), 5.39 (d, *J*=9.8 Hz, 1H, 5-H), 6.04 (dd, *J*=14.6, 0.8 Hz, 1H, 9-H), 6.23 (brs, 1H, 3-H), 6.70 (dd, *J*=14.4, 8.1 Hz, 1H, 8-H), 9.30 (s, 1H, 1-H); ^{13}C NMR (100.6 MHz, C_6D_6): δ=5.7, 5.8 ($SiCH_2CH_3$), 7.38, 7.40 ($SiCH_2CH_3$), 10.9 (2-CH_3), 16.2 (4-CH_3), 16.8 (6-CH_3), 18.7 (C-6 gluco), 37.8 (C-6), 60.4 (OCH_3), 71.5 (C-5 gluco), 76.6 (C-2 gluco), 78.5, 78.6 (C-9, C-3 gluco), 86.2 (C-7), 86.7 (C-4 gluco), 102.4 (C-1 gluco), 133.8, 136.7 (C-2, C-4), 139.2 (C-5), 145.5 (C-8), 153.0 (C-3), 194.7 (C-1); IR (film): $\tilde{\nu}$=2954 (s), 2909 (s), 2872 (s), 2830 (s), 1675 (s), 1607 (s), 1462 (s), 1414 (s), 1379 (s), 1281 (s), 1154 (s), 1116 (s), 811 (s), 747 cm^{-1} (s).

Cyanomethyl (2*E*,4*E*,6*E*,10*E*,8*R*,9*S*)-9-[6-deoxy-4-*O*-methyl-2,3-*O*-bis(triethylsilyl)-α-L-glucopyranosyl]-11-iodo-2,4,6,8-tetramethylundecatetra-2,4,6,10-enoate (43): *Horner–Emmons olefination:* $(EtO)_2P(O)CH(CH_3)CO_2H$ (260 mg, 1.24 mmol) in THF (2 mL) was added to a suspension of NaH (88 mg, 2.2 mmol, 60 % in mineral oil) in THF (8 mL) at 0 °C within 20 min. The reaction mixture was stirred for 20 min. Then al-

dehyde **41** (147 mg, 207 μmol) in THF (5 mL) was added. The mixture was stirred at 0 °C for 1 h and was then heated to 35 °C. The mixture formed a gel after 20 min stirring at 35 °C. MTBE (10 mL) and NH_4Cl (10 mL) were added, the layers were separated and the aqueous layer was extracted with MTBE (3×20 mL). The combined organic layers were washed with brine (30 mL), dried with Na_2SO_4 and the solvents were evaporated. The crude product was purified by flash chromatography (15 g silica gel, pentane/MTBE 6:2 → 1:1) to give the corresponding acid (137 mg, 179 μmol, 87 %) as a colorless oil. R_f=0.20 (*n*-hexane/acetone 3:1); $[\alpha]_D^{20}$=+22.9 (c=1.20, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ= 0.72 (q, J=7.9 Hz, 6H, $SiCH_2CH_3$), 0.85 (q, J=7.9 Hz, 6H, $SiCH_2CH_3$), 0.97 (d, J=6.9 Hz, 3H, 8-CH_3), 1.09 (t, J=7.9 Hz, 9H, $SiCH_2CH_3$), 1.14 (t, J=8.0 Hz, 9H, $SiCH_2CH_3$), 1.31 (d, J=6.2 Hz, 3H, 6-H_3 gluco), 1.56 (d, J=0.9 Hz, 3H, 6-CH_3), 1.85 (d, J=1.0 Hz, 3H, 4-CH_3), 2.06 (d, J= 1.2 Hz, 3H, 2-CH_3), 2.56–2.65 (m, 1H, 8-H), 2.64 (t, J=9.2 Hz, 1H, 4-H gluco), 3.32 (s, 3H, OCH_3), 3.65 (dd, J=9.3, 3.3 Hz, 1H, 2-H gluco), 3.80 (dd, J=8.1, 6.5 Hz, 1H, 9-H), 3.86 (dq, J=9.6, 6.2 Hz, 1H, 5-H gluco), 4.11 (t, J=9.1 Hz, 1H, 3-H gluco), 4.83 (d, J=3.4 Hz, 1H, 1-H gluco), 5.13 (d, J=9.9 Hz, 1H, 7-H), 5.91 (s, 1H, 5-H), 6.11 (d, J=14.4 Hz, 1H, 11-H), 6.42 (dd, J=14.6, 8.4 Hz, 1H, 10-H), 7.52 (s, 1H, 3-H); ^{13}C NMR (125 MHz, $CDCl_3$): δ=5.6, 5.8 (2×$SiCH_2CH_3$), 7.35, 7.38 (2×$SiCH_2CH_3$), 13.9 (2-CH_3), 16.9 (8-CH_3), 17.2 (6-CH_3), 18.4 (4-CH_3), 18.6 (C-6 gluco), 37.7 (C-8), 61.1 (OCH_3), 68.3 (C-5 gluco), 74.4, 74.5 (C-2 gluco, C-3 gluco), 81.1 (C-11), 81.6 (C-9), 87.7 (C-4 gluco), 96.3 (C-1 gluco), 125.5 (C-2), 132.4, 133.1 (C-4, C-6), 133.5 (C-7), 139.9 (C-5), 144.5 (C-10), 146.2 (C-3), 174.7 (C-1); IR (film): $\tilde{\nu}$=3460–3510 (br s), 2957 (s), 2875 (s), 2851 (s), 1683 (s), 1463 (s), 1415 (s), 1379 (s), 1278 (s), 1239 (s), 1173 (s), 1112 (s), 749 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{34}H_{61}IO_7Si_2Na$: 787.2898; found 787.2861 $[M+Na]^+$.

Cyanomethyl esterification: The acid (240 mg, 450 μmol) was dissolved in MeCN (2 mL) and cooled to 0 °C. NEt_3 (1.0 mL, 72 mmol) and $ClCH_2CN$ (0.50 mL, 7.9 mmol) were added. The cooling bath was removed and the mixture was stirred for 14 h at 20 °C. The reaction was quenched with MTBE (5 mL)/phosphate buffer (5 mL, 1.0 M, pH 7), the layers were separated and the aqueous layer was extracted with MTBE (3×20 mL). The combined organic layers were washed with brine (10 mL), dried with $MgSO_4$ and the solvent was evaporated. The crude product was purified by flash chromatography (10 g silica gel, pentane/MTBE 8:1) to give cyanomethyl ester **43** (132 mg, 164 μmol, 92 %) as a colorless oil. R_f=0.41 (*n*-hexane/MTBE 3:1); $[\alpha]_D^{20}$=+17.9 (c=0.58, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ=0.72 (q, J=8.1 Hz, 6H, $SiCH_2CH_3$), 0.84 (q, J= 8.2 Hz, 6H, $SiCH_2CH_3$), 0.96 (d, J=6.6 Hz, 3H, 8-CH_3), 1.09 (t, J= 8.0 Hz, 9H, $SiCH_2CH_3$), 1.13 (t, J=8.0 Hz, 9H, $SiCH_2CH_3$), 1.30 (d, J= 6.4 Hz, 3H, 6-H_3 gluco), 1.57 (d, J=1.1 Hz, 3H, 6-CH_3), 1.83 (d, J= 1.1 Hz, 3H, 4-CH_3), 1.92 (d, J=1.4 Hz, 3H, 2-CH_3), 2.55–2.64 (m, 1H, 8-H), 2.63 (t, J=9.2 Hz, 1H, 4-H gluco), 3.32 (s, 3H, OCH_3), 3.64 (dd, J= 9.3, 3.3 Hz, 1H, 2-H gluco), 3.77–3.88 (m, 2H, 9-H, 5-H gluco), 3.81 (s, 2H, OCH_2CN), 4.10 (t, J=9.0 Hz, 1H, 3-H gluco), 4.82 (d, J=3.4 Hz, 1H, 1-H gluco), 5.15 (d, J=9.9 Hz, 1H, 7-H), 5.88 (s, 1H, 5-H), 6.12 (d, J=14.4 Hz, 1H, 11-H), 6.42 (dd, J=14.7, 8.2 Hz, 1H, 10-H), 7.23 (s, 1H, 3-H); ^{13}C NMR (125 MHz, $CDCl_3$): δ=5.6, 5.8 (2×$SiCH_2CH_3$), 7.3, 7.4 (2×$SiCH_2CH_3$), 14.0 (2-CH_3), 16.8 (8-CH_3), 17.2 (6-CH_3), 18.3 (4-CH_3), 18.6 (C-6 gluco), 37.7 (C-8), 48.1 (OCH_2CN), 61.1 (OCH_3), 68.3 (C-5 gluco), 74.4, 74.5 (C-2 gluco, C-3 gluco), 81.2 (C-11), 81.6 (C-9), 87.7 (C-4 gluco), 96.3 (C-1 gluco), 115.0 (OCH_2CN), 124.2 (C-2), 132.0, 133.2 (C-4, C-6), 133.8 (C-7), 140.3 (C-5), 144.4 (C-10), 146.2 (C-3), 168.8 (C-1); IR (film): $\tilde{\nu}$=2957 (s), 2913 (s), 2874 (s), 2850 (s), 2829 (s), 1724 (s), 1604 (s), 1239 (s), 1172 (s), 1140 (s), 1094 (s), 748 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{36}H_{62}INO_7Si_2Na$: 826.3007; found 826.3026 $[M+Na]^+$.

Cyanomethyl (2*E*,4*E*,6*E*,10*E*,8*R*,9*S*)-9-[6-deoxy-4-*O*-methyl-2,3-*O*-bis(triethylsilyl)-β-L-glucopyranosyl]-11-iodo-2,4,6,8-tetramethylundecatetra-2,4,6,10-enoate (44): According to the procedure for the conversion of the α-anomer **41** into the α-anomeric cyanomethyl ester **43**, the β-anomeric aldehyde **42** (34 mg, 48 μmol) was transformed into the β-anomeric cyanomethyl ester **44** (30 mg, 37 μmol, 78 %). R_f=0.40 (*n*-hexane/MTBE 3:1); $[\alpha]_D^{20}$=+57.9 (c=1.45, $CHCl_3$); ^{1}H NMR (400 MHz, C_6D_6): δ= 0.77–0.92 (m, 12H, 2×$SiCH_2CH_3$), 1.00 (d, J=6.8 Hz, 3H, 8-CH_3), 1.11 (t, J=7.9 Hz, 9H, $SiCH_2CH_3$), 1.12 (t, J=7.9 Hz, 9H, $SiCH_2CH_3$), 1.23 (d, J=6.4 Hz, 3H, 6-H_3 gluco), 1.65 (d, J=0.9 Hz, 3H, 6-CH_3), 1.82 (d, J=1.1 Hz, 3H, 4-CH_3), 1.90 (d, J=1.1 Hz, 3H, 2-CH_3), 2.58 (t, J= 8.9 Hz, 1H, 4-H gluco), 2.76–2.87 (m, 1H, 8-H), 3.11 (dq, J=9.4, 6.2 Hz, 1H, 5-H gluco), 3.17 (s, 3H, OCH_3), 3.51–3.60 (m, 2H, (2–3)-H gluco), 3.71 (t, J=7.2 Hz, 1H, 9-H), 3.83 (s, 2H, OCH_2CN), 4.12 (d, J=7.0 Hz, 1H, 1-H gluco), 5.21 (d, J=9.8 Hz, 1H, 7-H), 5.89 (s, 1H, 5-H), 6.05 (d, J=14.4 Hz, 1H, 11-H), 6.74 (dd, J=14.5, 8.0 Hz, 1H, 10-H), 7.23 (s, 1H, 3-H); ^{13}C NMR (100.6 MHz, $CDCl_3$): δ=5.75, 5.80 (2×$SiCH_2CH_3$), 7.4 (2×$SiCH_2CH_3$), 14.1 (2-CH_3), 17.1, 17.3 (8-CH_3, 6-CH_3), 18.2 (4-CH_3), 18.8 (C-6 gluco), 38.0 (C-8), 48.1 (OCH_2CN), 60.4 (OCH_3), 71.5 (C-5 gluco), 76.7 (C-2 gluco or C-3 gluco), 78.4, 78.5 (C-11, C-2 gluco or C-3 gluco), 86.5 (C-9), 86.7 (C-4 gluco), 102.4 (C-1 gluco), 115.0 (OCH_2CN), 124.1 (C-2), 132.1, 132.2 (C-4, C-6), 133.6 (C-7), 140.7 (C-5), 146.0 (C-10), 146.3 (C-3), 166.9 (C-1); IR (film): $\tilde{\nu}$=2956 (w), 2911 (s), 2875 (s), 1721 (s), 1607 (s), 1461 (m), 1417 (m), 1301 (s), 1239 (s), 1168 (s), 1107 (s), 1085 (s), 1007 cm^{-1} (s); HR-MS (ESI) m/z: calcd for $C_{36}H_{62}INO_7Si_2Na$: 826.3007; found 826.3001 $[M+Na]^+$.

(1′*E*,2*R*,3*R*,4*S*,5*R*,6*R*,4′*S*,2″*R*)-2-[-5′-Benzyloxy-4′-methoxy-1′-pentenyl]-6-[2″-*tert*-butyldimethylsilyloxy-3″-methoxypropyl]-4-hydroxy-2-methoxy-3,5-dimethyl-4-trimethylsilyloxy-2,3,5,6-tetrahydro-4*H*-pyran (46): Alcohol **45** (2.1 g, 3.7 mmol) was dissolved in CH_2Cl_2 (70 mL) and TMS-imidazole (0.83 mL, 5.6 mmol) was added at 0 °C. After stirring for 2.5 h at 0 °C phosphate buffer (40 mL, 1 M, pH 7) and MTBE (50 mL) were added. The two layers were separated and the aqueous layer was extracted with MTBE (3×40 mL). The combined organic layers were washed with brine (80 mL), dried with $MgSO_4$, concentrated and the residue was purified by flash chromatography (250 g silica gel, pentane/MTBE 5:1) to yield silyl ether **46** (2.22 g, 3.47 mmol, 94 %) as a colorless oil. R_f=0.29 (*n*-hexane/MTBE 4:1); $[\alpha]_D^{24}$=+60.6 (c=1.21, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$): δ=0.05 (2s, 6H, $SiCH_3$), 0.09 (s, 9H, $Si(CH_3)_3$), 0.82–0.89 (m, 15H, 5-CH_3, 3-CH_3, $SiC(CH_3)_3$), 1.45 (ddd, J=14.2, 7.4, 3.6 Hz, 1H, 1″-H), 1.53 (dq, J=10.7, 6.6 Hz, 1H, 3-H), 1.60–1.71 (m, 1H, 5-H), 1.72 (ddd, J=14.3, 8.2, 4.6 Hz, 1H, 1″-H), 2.25–2.34 (m, 2H, 3′-H_2), 3.04 (s, 3H, 2-OCH_3), 3.25 (dd, J=9.8, 6.4 Hz, 1H, 3″-H), 3.30 (s, 3H, OCH_3), 3.32–3.41 (m, 2H, 3″-H, 4′-H), 3.39 (s, 3H, OCH_3), 3.41–3.48 (m, 1H, 5′-H_2), 3.76 (dd, J=10.6, 4.8 Hz, 1H, 4-H), 3.81–3.95 (m, 2H, 6-H, 2″-H), 4.49 (d, J=12.2, 1H, CHPh), 4.54 (d, J=12.0, 1H, CHPh), 5.41 (br d, J= 15.6 Hz, 1H, 1′-H), 5.74 (dt, J=15.6, 7.3 Hz, 1H, 2′-H), 7.22–7.34 (m, 5H, Ph); ^{13}C NMR (75.5 MHz, $CDCl_3$): δ=−4.7, −3.8, 0.3 ($SiCH_3$), 5.1 (5-CH_3), 11.6 (3-CH_3), 18.2 ($SiC(CH_3)_3$), 26.0 ($SiC(CH_3)_3$), 34.0 (C-3′), 38.7 (C-1″), 40.0 (C-5), 40.6 (C-3), 48.9 (2-OCH_3), 57.5, 58.8 (4′-OCH_3, 3″-OCH_3), 67.9 (C-6), 70.2 (C-2″), 71.6 (C-5′), 73.38 (CH_2Ph), 73.42 (C-4), 77.8 (C-3″), 79.8 (C-4′), 101.2 (C-2), 127.59, 127.63, 128.4, 138.2 (Ph), 128.8 (C-2′), 131.9 (C-1′); IR (film): $\tilde{\nu}$=2949 (s), 2891 (s), 2858 (s), 1460 (m), 1251 (s), 1108 (s), 1067 (s), 838 cm^{-1} (s); HR-MS (EI): m/z: calcd for $C_{34}H_{62}O_7Si_2$: 638.4034; found 638.4033 $[M]^+$.

(2*R*,3*R*,4*S*,5*R*,6*R*,1′*R*,2′*S*,4′*S*,2″*R*)-2-(1′,2′-Diacetoxy-5′-benzyloxy-4′-methoxy-1′-pentyl)-6-(2″-*tert*-butyldimethylsilyloxy-3″-methoxypropyl)-2-methoxy-3,5-dimethyl-4-trimethylsilyloxy-2,3,5,6-tetrahydro-4*H*-pyran (47): Alkene **46** (2.18 g, 3.41 mmol) was dissolved in *t*BuOH (30 mL) and H_2O (14 mL) and cooled to 0 °C. $[K_2OsO_2(OH)_4]$ (75 mg, 0.20 mmol), NMO (1.2 g, 10 mmol) were added and the mixture was stirred for 7 d between 0–8 °C (TLC control *n*-hexane/MTBE 1:1). The reaction was quenched with $Na_2S_2O_3$ (8 g) in H_2O (50 mL) and MTBE (50 mL). The yellow solution was stirred for 1 h meanwhile the color changed to black. The aqueous layer was extracted with MTBE (3×40 mL). The combined organic layers were washed with brine (80 mL), dried with $MgSO_4$ and concentrated. The crude product was dissolved in pyridine (50 mL) at cooled to 0 °C. Ac_2O (17 mL, 0.18 mmol) and DMAP (20 mg, 0.16 mmol) were added. The cooling bath was removed and the mixture was stirred 4 h at 40 °C. After cooling, phosphate buffer (50 mL, 1 M, pH 7) and MTBE (50 mL) were added. The two layers were separated and the aqueous layer was extracted with MTBE (3×30 mL). The combined organic layers were washed with brine (50 mL), dried with $MgSO_4$, concentrated and the residue was azeotroped with toluene (3×20 mL). The crude product was purified by flash chromatography (270 g silica gel, pentane/MTBE 4:1) to yield bis(acetate) **47** (2.0 g, 2.9 mmol, 85 %, two steps) as a colorless oil. Furthermore, the minor diastereomer (315 mg, 416 μmol, 12 %) was obtained as a colorless oil. R_f=0.47 (*n*-hexane/MTBE 1:1); $[\alpha]_D^{26}$=+38.7 (c=1.02, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$):

$\delta = 0.02$, 0.03 (2s, 6H, $SiCH_3$), 0.07 (s, 9H, $Si(CH_3)_3$), 0.81–0.88 (m, 12H, $SiC(CH_3)_3$, 5-CH_3), 1.01 (d, $J = 6.6$ Hz, 3H, 3-CH_3), 1.44 (ddd, $J = 14.3$, 7.8, 3.4 Hz, 1H, 1″-H), 1.58–1.72 (m, 3H, 5-H, 1″-H, 3′-H), 1.83 (dq, $J =$ 10.4, 6.5 Hz, 1H, 3-H), 1.94–2.03 (m, 1H, 3′-H), 1.99, 2.06 (2s, 6H, OAc), 3.09 (s, 3H, OCH_3), 3.17–3.31 (m, 3H, 3″-H_2, 4′-H), 3.27, 3.35 (2s, 6H, OCH_3), 3.40–3.46 (m, 2H, 5-H_2), 3.71 (dd, $J = 10.3$, 4.6 Hz, 1H, 4-H), 3.79–3.93 (m, 2H, 2″-H, 6-H), 4.51 (s, 2H, CH_2Ph), 5.00 (d, $J = 6.1$ Hz, 1H, 1′-H), 5.41 (ddd, $J = 9.5$, 6.2, 3.2 Hz, 1H, 2′-H), 7.21–7.35 (m, 5H, Ph); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta = -5.0$, −4.0, 0.0 ($SiCH_3$), 4.9 (5-CH_3), 10.8 (3-CH_3), 18.0 ($SiC(CH_3)_3$), 20.7 (2×OAc), 25.7 ($SiC(CH_3)_3$), 35.5 (C-3′), 36.1 (C-3), 38.2 (C-1″), 39.4 (C-5), 47.7 (2-OCH_3), 57.9 (4′-OCH_3), 58.5 (3″-OCH_3), 68.7 (C-2′), 68.9 (C-6), 69.6 (C-2″), 72.0 (C-5′), 72.9 (C-4, C-1′), 73.1 (CH_2Ph), 76.3 (C-4′), 77.3 (C-3″), 100.6 (C-2), 127.29, 127.31, 128.1, 138.0 (Ph), 169.6, 169.8 (2×OAc); IR (film): $\tilde{\nu} =$ 2953 (s), 2932 (s), 2893 (s), 2858 (s), 1748 (s), 1463 (w), 1248 (s), 1102 (s), 1072 (s), 838 cm^{-1} (m); HR-MS (FAB): m/z: calcd for $C_{38}H_{68}O_{11}Si_2Na$: 779.4198; found 779.4189 $[M+Na]^+$; minor diastereomer: $R_f = 0.40$ (*n*-hexane/MTBE 1:1); $[\alpha]_D^{24} = +43.5$ ($c = 1.00$, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$): $\delta = 0.035$, 0.040, 0.07 (3s, 15H, Si-CH_3), 0.81 (d, $J = 7.0$ Hz, 3H, 5-CH_3), 0.86 (s, 9H, Si-$C(CH_3)_3$), 0.89 (d, $J = 6.8$ Hz, 3H, 3-CH_3), 1.44 (ddd, $J = 14.2$, 7.6, 3.8 Hz, 1H, 1″-H_2), 1.56–1.70 (m, 2H, 5-H, 1″-H_2), 1.95–2.07 (m, 3H, 3-H, 3′-H_2), 1.99, 2.05 (2s, 6H, OAc), 3.21–3.37 (m, 3H, 4′-H, 3″-H_2), 3.27, 3.30, 3.32 (3s, 9H, 2-OCH_3, 4′-OCH_3, 3″-OCH_3), 3.40–3.47 (m, 2H, 5′-H_2), 3.64 (dd, $J = 10.3$, 4.8 Hz, 1H, 4-H), 3.73–3.78 (m, 1H, 6-H), 3.82–3.95 (m, 1H, 2″-H), 4.48–4.54 (m, 2H, CH_2Ph), 5.19 (d, $J = 6.1$ Hz, 1H, 1′-H), 5.33–5.45 (m, 1H, 2′-H), 7.22–7.36 (m, 5H, Ph); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta = -4.9$, −4.0, 0.0 (Si-CH_3), 4.8 (5-CH_3), 11.5 (3-CH_3), 18.0 (Si-$C(CH_3)_3$), 20.8, 20.9 (2 OAc), 25.7 (Si-$C(CH_3)_3$), 33.6 (C-3′), 37.3 (C-3), 38.3 (C-1″), 39.2 (C-5), 49.4 (2-OCH_3), 56.8 (4′-OCH_3), 58.5 (3″-OCH_3), 69.0, 69.1 (C-6, C-2′), 69.8 (C-2″), 70.8 (C-5′), 73.0 (CH_2Ph), 73.7 (C-4), 74.3 (C-1′), 77.1 (C-4′), 77.4 (C-3″), 101.0 (C-2), 127.3, 127.4, 128.1, 138.0 (Ph), 169.7, 169.8 (2 OAc); HR-MS (FAB): m/z: calcd for $C_{38}H_{68}O_{11}Si_2Na$: 779.4191; found 779.4189 $[M+Na]^+$.

(2*R*,3*R*,4*S*,5*R*,6*R*,1′*R*,2′*S*,4′*S*,2″*R*)-2-(1′,2′-Diacetoxy-5′-benzyloxy-4′-methoxypentyl)-4-hydroxy-6-(2″-hydroxy-3″-methoxypropyl)-2-methoxy-3,5-dimethyl-2,3,5,6-tetrahydro-4*H*-pyran (48): Disilyl ether **47** (2.0 g, 2.9 mmol) was dissolved in THF (30 mL) and cooled to 0 °C. TBAF (2.75 g, 8.7 mmol) was added and the cooling bath was removed. After stirring for 16 h, phosphate buffer (30 mL, 1 M, pH 7) was added and aqueous layer was extracted with AcOEt (3×30 mL). The combined organic layers were washed with brine (50 mL), dried with $MgSO_4$, concentrated and the residue was purified by flash chromatography (40 g silica gel, $CHCl_3$/MeOH 9:1) to yield diol **48** (1.61 g, 2.82 mmol, 97 %) as a colorless oil. $R_f = 0.41$ ($CHCl_3$/MeOH 9:1); $[\alpha]_D^{21} = +37.4$ ($c = 0.90$, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$): $\delta = 0.77$ (d, $J = 6.6$ Hz, 3H, 5-CH_3), 1.04 (d, $J = 6.6$ Hz, 3H, 3-CH_3), 1.14–1.30 (m, 1H, 1″-H), 1.44–1.66 (m, 1H, 1″-H, 3′-H), 1.47 (d, $J = 5.5$ Hz, 1H, OH), 1.67–1.82 (m, 2H, 3-H, 5-H), 1.85–1.97 (m, 1H, 3′-H), 1.94, 2.01 (2s, 6H, OAc), 2.25 (d, $J = 3.3$ Hz, 1H, 2″-OH), 3.05 (s, 3H, OCH_3), 3.06–3.21 (m, 2H, 4′-H, 3″-H), 3.22–3.30 (m, 1H, 3″-H), 3.27, 3.29 (2s, 6H, OCH_3), 3.34 (dd, $J = 10.3$, 5.6 Hz, 1H, 5′-H), 3.40 (dd, $J = 10.3$, 4.3 Hz, 1H, 5′-H), 3.71 (dt, $J = 10.4$, 5.1 Hz, 1H, 4-H), 3.83–3.98 (m, 2H, 2″-H, 6-H), 4.44 (s, 2H, CH_2Ph), 4.97 (d, $J =$ 5.3 Hz, 1H, 1′-H), 5.32–5.40 (m, 1H, 2′-H), 7.15–7.31 (m, 5H, Ph); ^{13}C NMR (75.5 MHz, $CDCl_3$): $\delta = 5.0$ (5-CH_3), 10.7 (3-CH_3), 20.89, 20.92 (OAc), 35.8 (C-3′), 36.2 (C-1″), 36.5 (C-3), 38.5 (C-5), 47.8 (2-OCH_3), 58.1, 58.9 (4′-OCH_3, 3″-OCH_3), 66.6 (C-2″), 67.8 (C-6), 68.8 (C-2′), 71.9 (C-5′), 72.3 (C-4), 72.9 (C-1′), 73.3 (CH_2Ph), 100.5 (C-2), 127.49, 127.54, 128.3, 138.2 (Ph), 169.8, 170.1 (OAc); IR (film): $\tilde{\nu} = 3468$ (brs), 2926 (s), 1744 (s), 1459 (m), 1229 (s), 1099 (s), 1048 (s), 1026 (m), 738 cm^{-1} (m); HR-MS (FAB): m/z: calcd for $C_{29}H_{46}O_{11}Na$: 593.2938; found 593.2933 $[M+Na]^+$.

(2*R*,3*R*,4*S*,5*R*,6*R*,1′*R*,2′*S*,4′*S*,2″*R*)-2-(1′,2′-Diacetoxy-5′-benzyloxy-4′-methoxypentyl)-4-triethylsilyloxy-6-(2″-hydroxy-3″-methoxypropyl)-2-methoxy-3,5-dimethyl-2,3,5,6-tetrahydro-4*H*-pyran (49): Diol **48** (813 mg, 1.42 mmol) was dissolved in CH_2Cl_2 (50 mL) and cooled to 0 °C. Imidazole (970 mg, 14.2 mmol) and TESCl (1.2 mL, 7.1 mmol) were added. After 1 h stirring at 0 °C, MTBE (100 mL) and $NaHCO_3$ (100 mL) were added. The two layers were separated and the aqueous layer was extracted with MTBE (3×80 mL). The combined organic layers were dried with $MgSO_4$, concentrated and the residue was filtered over 10 g silica gel (pentane/MTBE 2:1). The solvents were removed and the residue was dissolved in THF (50 mL) and cooled to 0 °C. TBAF (530 mg, 1.68 mmol) in THF (5 mL) was added within 10 min. After stirring for 30 min at 0 °C MTBE (70 mL) and phosphate buffer (50 mL, 1 M, pH 7) were added. The two layers were separated and the aqueous layer was extracted with MTBE (3×50 mL). The combined organic layers were washed with brine (50 mL), dried with $MgSO_4$, concentrated and the residue purified by flash chromatography (40 g silica gel, pentane/MTBE 2:3) to yield monosilyl ether **49** (745 mg, 1.09 mmol, 77 %, two steps) as a colorless oil. $R_f =$ 0.34 (*n*-hexane/MTBE 1:2); $[\alpha]_D^{24} = +45.1$ ($c = 0.85$, $CHCl_3$); ^{1}H NMR (400 MHz, C_6D_6): $\delta = 0.59$ (q, $J = 8.1$ Hz, 6H, $SiCH_2CH_3$), 0.99 (t, $J =$ 7.9 Hz, 9H, $SiCH_2CH_3$), 1.17 (d, $J = 6.9$ Hz, 3H, 5-CH_3), 1.25–1.34 (m, 1H, 1″-H), 1.52 (d, $J = 6.7$ Hz, 3H, 3-CH_3), 1.61–1.70 (m, 1H, 1″-H), 1.73–1.82 (m, 1H, 5-H), 1.76, 1.79 (2s, 6H, OAc), 1.89–1.98 (m, 1H, 3′-H), 2.11 (brs, 1H, OH), 2.20–2.33 (m, 2H, 3-H, 3′-H), 2.92 (dd, $J = 8.3$, 8.5 Hz, 1H, 3″-H), 3.04–3.08 (m, 1H, 3″-H), 3.02, 3.33, 3.36 (3s, 9H, OCH_3), 3.34–3.47 (m, 3H, 5′-H_2, 4′-H), 3.99–4.07 (m, 1H, 2″-H), 4.08 (dd, $J = 10.3$, 4.8 Hz, 1H, 4-H), 4.27–4.36 (m, 3H, 6-H, CH_2Ph), 5.49 (d, $J =$ 5.0 Hz, 1H, 1′-H), 5.90–5.97 (m, 1H, 2′-H), 7.05–7.30 (m, 5H, Ph); ^{13}C NMR (100.6 MHz, C_6D_6): $\delta = 5.4$ ($SiCH_2CH_3$), 5.8 (5-CH_3), 7.2 ($SiCH_2CH_3$), 11.8 (3-CH_3), 20.55, 20.60 (2×OAc), 36.8, 36.9 (C-1″, C-3′), 37.6 (C-3), 40.3 (C-5), 48.1 (2-OCH_3), 58.1, 58.6 (2×OCH_3), 66.7 (C-2″), 68.1 (C-6), 69.3 (C-2′), 72.6 (C-5′), 73.4 (CH_2Ph), 73.6, 73.7 (C-4, C-1′), 77.1 (C-4′), 77.7 (C-3″), 101.4 (C-2), 127.6, 127.7, 128.5 (Ph), 139.1 (C_q-Ph), 169.4, 169.7 (OAc); IR (film): $\tilde{\nu} = 3478$ (brs), 3064 (w), 2950 (s), 2912 (s), 2876 (s), 1743 (s), 1456 (s), 1372 (s), 1227 (s), 1075 (s), 850 (s), 743 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{35}H_{60}O_{11}SiNa$: 707.3803; found 707.3777 $[M+Na]^+$.

(2*R*,3*R*,4*S*,5*R*,6*R*,1′*R*,2′*S*,4′*S*,2″*R*)-2-(1′,2′-Diacetoxy-5′-hydroxy-4′-methoxypentyl)-4-triethylsilyloxy-6-[2″-{4-*O*-(4-*O*-*tert*-butyldimethylsilyl-3-*O*-methyl-β-D-oleandropyranosyl)-3-*O*-triethylsilyl-L-olivomycopyranosyl}-3″-methoxypropyl]-2-methoxy-3,5-dimethyl-2,3,5,6-tetrahydro-4*H*-pyran (50): *Glycosylation:* Disaccharide glycosyldonor **20** (289 mg, 559 μmol) and glycosylacceptor **49** (322 mg, 470 μmol) were combined and azeotroped with toluene (3×5 mL). The mixture was dissolved in CH_2Cl_2 (10 mL). MS 4 Å (1.4 g, powder) was added and the suspension was stirred for 1 h at 20 °C. The mixture was cooled to 0 °C and NIS (190 mg, 844 μmol) was added in one portion. The mixture was allowed to warm to 20 °C and was stirred for 72 h. The mixture was filtered over pad of Celite and washed with MTBE (50 mL). $NaHCO_3$ (15 mL) and $Na_2S_2O_3$ (3 g) were added and the mixture was stirred for 20 min. After separation of the layers the aqueous layer was extracted with MTBE (3×30 mL). The combined organic layers were washed with brine (50 mL), dried with $MgSO_4$, concentrated and filtered over 10 g silica gel with pentane/MTBE 2:1. The solvents were removed and the crude glycoconjugate (329 mg, 248 μmol, 53 %) so obtained was used for the next step without further purification.

Iodide reduction: The crude iodide was dissolved in toluene (10 mL) and Bu_3SnH (660 μL, 2.50 mmol) was added. The mixture was degassed by FTP (freeze/thaw process) and heated to 100 °C. AIBN (41 mg, 0.25 mmol) was added in one portion and the mixture was stirred for 15 min. After cooling the solvent was removed in vacuo and the residue was filtered over silica gel (10 g) with pentane/MTBE 50:1→3:1.

Fluoride washing: The solvents were removed and the residue was dissolved in Et_2O (2.5 mL) and 1 M KF (2.5 mL) was added. After 3 h the mixture was filtered over pad of celite and washed with Et_2O (15 mL). The aqueous layer was extracted with MTBE (2×10 mL). The combined organic layers were washed with brine (10 mL), dried with $MgSO_4$ and concentrated.

Benzyl ether cleavage: The crude product (288 mg, 240 μmol, 96 %) was dissolved in AcOEt/MeOH (14 mL, 1:1). Ammonium formiate (66 mg, 1.0 mmol) and $Pd(OH)_2$/C (250 mg, 420 μmol) were added and the mixture was stirred at 20 °C under a hydrogen atmosphere. The reaction was followed by TLC (*n*-hexane/MTBE 1:2). After 1 h, 125 mg of the catalyst was added and the mixture was stirred for further 4 h. The mixture was filtered over a pad of celite and the solvents were removed in vacuo. The residue was purified by flash chromatography (25 g silica gel, pentane/

MTBE 2:3) to yield alcohol **50** (175 mg, 157 μmol, 76%) as a colorless oil. R_f=0.42 (*n*-hexane/MTBE 1:4); $[\alpha]_D^{19}=-8.0$ (c=1.13, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ=0.12, 0.20 (2s, 6H, $SiCH_3$), 0.53–0.63 (m, 12H, 2×$SiCH_2CH_3$), 0.95–1.02 (m, 27H, 2×$SiCH_2CH_3$, $SiC(CH_3)_3$), 1.17 (d, J=7.0 Hz, 3H, 5-CH_3), 1.40 (d, J=6.0 Hz, 3H, 6-H_3 olean.), 1.50 (d, J=6.6 Hz, 3H, 3-CH_3), 1.60–1.67 (m, 2H, 5′-OH, 2-H olean.), 1.67–1.86 (m, 3H, 1″-H, 3′-H, 5-H), 1.69 (d, J=6.0 Hz, 3H, 6-H_3 olivo.), 1.72 (s, 3H, 3-CH_3 olivo), 1.74, 1.78 (2s, 6H, OAc), 1.93 (dd, J=12.7, 4.1 Hz, 1H, 2-H olivo), 2.01 (ddd, J=14.4, 9.5, 3.6 Hz, 1H, 1″-H), 2.07 (d, J=13.0 Hz, 1H, 2-H olivo.), 2.20–2.28 (m, 1H, 3-H), 2.33 (ddd, J=14.5, 9.1, 4.2 Hz, 1H, 3′-H), 2.58 (ddd, J=12.3, 4.7, 1.4 Hz, 1H, 2-H olean.), 3.11, 3.13 (2s, 6H, 2×OCH_3), 3.15–3.24 (m, 2H, 4′-H, 3-H-olean), 3.19, 3.28 (2s, 6H, OCH_3), 3.31 (dd, J=8.4, 8.4 Hz, 1H, 4-H olean), 3.33–3.43 (m, 2H, 5′-H, 5-H olean), 3.45–3.51 (m, 2H, 3″-H_2), 3.55–3.61 (m, 1H, 5′-H), 3.73 (d, J=9.9 Hz, 1H, 4-H olivo.), 3.87–3.93 (m, 1H, 2″-H), 4.03–4.10 (m, 3H, 6-H, 4-H, 5-H olivo), 4.92 (d, J=4.0 Hz, 1H, 1-H olivo.), 5.12 (dd, J=9.8, 1.4 Hz, 1H, 1-H olean.), 5.43 (d, J=5.8 Hz, 1H, 1″-H), 5.43 (d, J=5.0 Hz, 1H, 1′-H), 5.77–5.83 (m, 1H, 2′-H); ^{13}C NMR (125.8 MHz, C_6D_6): δ=−4.6, −3.6 ($SiCH_3$), 5.4 ($SiCH_2CH_3$), 5.6 (5-CH_3), 7.2, 7.27, 7.34 (2×$SiCH_2CH_3$, $SiCH_2CH_3$), 11.7 (3-CH_3), 18.6 ($SiC(CH_3)_3$), 18.9, 19.0 (C-6 olean, C-6 olivo), 20.50, 20.53 (2xOAc), 24.0 (3-CH_3 olivo), 26.3 ($SiC(CH_3)_3$), 35.90, 35.93 (C-1″, C-3′), 36.4 (C-2 olean), 37.4 (C-3), 40.3 (C-5), 45.8 (C-2 olivo), 48.1 (2-OCH_3), 55.6, 57.5, 58.9 (3×OCH_3), 63.6 (C-5′), 66.9 (C-6), 69.28, 69.34 (C-2′, C-5 olivo.), 73.1, 73.2 (C-1′,C-5 olean), 73.6 (C-4), 75.1 (C-2″), 75.5 (C-3″), 76.2 (C-3 olivo), 77.5 (C-4 olean), 78.4 (C-3 olean), 81.8 (C-4′), 85.5 (C-4 olivo), 97.1 (C-1 olivo.), 101.1 (C-1 olean), 101.5 (C-2), 169.4, 169.6 (2×OAc); IR (film): $\tilde{\nu}$=3470 (brs), 2984 (s), 2959 (s), 2876 (s), 1751 (s), 1737 (s), 1468 (s), 1373 (s), 1272 (s), 1250 (s), 1167 (s), 1124 (s), 875 (s), 836 (s), 759 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{54}H_{106}O_{17}Si_3Na$: 1133.6636; found 1133.6650 $[M+Na]^+$.

(2*E*,6*S*,7*S*,9*S*,10*R*,2′*R*,3′*R*,4′*S*,5′*R*,6′*R*,2″*R*)-10-[6′-{2″-(4-*O*-(4-*O*-*tert*-butyldimethylsilyl-3-*O*-methyl-β-D-oleandropyranosyl)-3-*O*-triethylsilyl-L-olivomycopyranosyl)-3″-methoxypropyl}-4′-triethylsilyloxy-2′-methoxy-3′,5′-dimethyl-2′,3′,5′,6′-tetrahydro-4*H*-pyran-2′-yl]-6,9,10-trihydroxy-7-methoxy-2-tri-*n*-butylstannyl-dec-2-ene (52): *Dess–Martin oxidation:* Dess–Martin periodinane (430 mg, 1.01 μmol) was dissolved in CH_2Cl_2 (4 mL) and pyridine (250 μL, 3.07 mmol) was added at 20°C. 1.4 mL of this stock solution were added to alcohol **50** (128 mg, 115 μmol) in CH_2Cl_2 (2 mL) at 20°C. After 1 h the mixture was quenched with $NaHCO_3$ (7 mL). Water (3 mL), $Na_2S_2O_3$ (1 g), MTBE (7 mL) were added, the two layers were separated and the aqueous layer was extracted with MTBE (3×10 mL). The combined organic layers were washed with brine (10 mL), dried with $MgSO_4$, concentrated and the residue was purified by flash chromatography (15 g silica gel, pentane/MTBE 3:1→1:1) to yield the corresponding aldehyde (107 mg, 96 μmol, 84%) as a colorless oil.

Grignard addition: Magnesium turnings (48 mg, 2.0 mmol) were dried under vacuum at 100°C with stirring. After cooling the flask was flushed with argon and Et_2O (1 mL, fresh distilled from K/Na) was added. Bromide **51** (438 mg, 1.00 mmol) was azeotroped with toluene (3×5 mL) and dissolved in Et_2O (1 mL). Dibromoethane (90 μL, 1.0 mmol) was added and the mixed bromides were slowly added to the magnesium turnings at 20°C. After complete addition, the mixture was stirred for 1 h and the volume was determined via syringe. Part of stock solution (1.3 mL, 0.68 mmol, 7 equiv) was placed in 25 mL nitrogen flask. Et_2O (3 mL) was added and the reaction was cooled to −78°C. The aldehyde (107 mg, 96 μmol) was azeotroped with toluene (3×5 mL), dissolved in Et_2O (1 mL) and slowly added to the Grignard solution. After 3 h stirring at −78°C the reaction was quenched with *i*PrOH (1 mL). The cooling bath was removed, NH_4Cl (10 mL) was added and the aqueous layer was extracted with MTBE (3×15 mL). The combined organic layers were washed with brine (20 mL), dried with $MgSO_4$, concentrated and the residue was purified by flash chromatography (12 g silica gel, neutral, pentane/MTBE 3:1 → 1:1) to yield the bis(acetoxy) alcohol (104 mg, 71 μmol, 74%) as a colorless oil (R_f=0.49, MTBE/*n*-hexane 1:1).

Acetate cleavage: KCN (120 mg, 1.8 mmol) at 20°C was added to a solution of diacetate (104 mg, 71 μmol) in MeOH (4 mL). The mixture was heated to 40°C and stirred for 16 h. After cooling MTBE (8 mL) was added and the mixture was filtered over a pad of Celite. The solvents were removed in vacuo and the residue was purified by flash chromatography (12 g silica gel, neutral, pentane/MTBE 2:1) to yield triol **52** (84 mg, 61 μmol, 86%) as a colorless oil. Furthermore diacetate (10 mg, 7.0 μmol, 10%) could be recovered. R_f=0.18 (*n*-hexane/MTBE 1:1); $[\alpha]_D^{20}=-8.1$ (c=0.80, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ=0.12, 0.21 (2s, 6H, $SiCH_3$), 0.55–0.64 (m, 12H, $SiCH_2CH_3$), 0.92–1.04 (m, 42H, Sn-$(CH_2)_3CH_3$, 2×$SiCH_2CH_3$, $SiC(CH_3)_3$, $SnCH_2C_3H_7$), 1.12 (d, J=6.9 Hz, 3H, 5′-CH_3), 1.36–1.45 (m, 12H, Sn(nBu)$_3$, 3′-CH_3, 6-H_3-olean.), 1.58–1.71 (m, 10H, Sn(nBu)$_3$, 2-H olean., 1″-H, 5-H_2), 1.69 (d, J=6.4 Hz, 3H, 6-H_3 olivo), 1.73 (s, 3H, 3-CH_3 Olivo.), 1.79–1.86 (m, 2H, 8-H, 5′-H), 1.92–2.00 (m, 3H, 8-H, 1″-H, 2-H olivo.), 2.02 (d, J=1.6 Hz, 3H, 1-H_3), 2.05–2.10 (m, 1H, 6-OH), 2.12 (d, J=12.6 Hz, 1H, 2-H olivo), 2.37–2.46 (m, 2H, 4-H, 3′-H), 2.48–2.57 (m, 1H, 4-H), 2.60 (ddd, J=12.4, 4.8, 1.7 Hz, 1H, 2-H olean.), 2.66 (d, J=5.5 Hz, 1H, 10-OH), 3.08–3.14 (m, 1H, 9-OH), 3.12, 3.13 (2s, 6H, OCH_3), 3.19 (ddd, J=11.5, 8.3, 4.9 Hz, 1H, 3-H olean), 3.25, 3.27 (2s, 6H, OCH_3), 3.31 (t, J=8.6 Hz, 1H, 4-H olean), 3.37–3.46 (m, 3H, 3″-H, 7-H, 5-H olean), 3.46 (dd, J=9.4, 4.6 Hz, 1H, 3″-H), 3.62 (dd, J=5.5, 2.8 Hz, 1H, 10-H), 3.60–3.66 (m, 1H, 6-H), 3.75 (d, J=9.9 Hz, 1H, 4-H olivo), 3.89–3.95 (m, 1H, 2″-H), 4.01–4.10 (m, 3H, 6′-H, 4′-H, 5-H olivo), 4.23–4.29 (m, 1H, 9-H), 5.00 (d, J=4.1 Hz, 1H, 1-H olivo), 5.12 (dd, J=9.7, 1.7 Hz, 1H, 1-H olean), 5.74–5.93 (m, 1H, 3-H); ^{13}C NMR (125.8 MHz, C_6D_6): δ=−4.6, −3.6 ($SiCH_3$), 5.5 ($SiCH_2CH_3$), 5.8 5′-CH_3), 7.2, 7.3, 7.4 (2×$SiCH_2CH_3$, $SiCH_2CH_3$), 9.5 ($SnCH_2C_3H_7$), 12.4 (3′-CH_3), 13.9 ($Sn(CH_2)_3CH_3$), 18.6 ($SiC(CH_3)_3$), 18.7, 18.9 (C-6 olean, C-6 olivo.), 19.4 (C-1), 23.9 (3-CH_3 olivo), 25.3 (C-4), 26.3 ($SiC(CH_3)_3$), 27.8, 29.7 ($SnCH_2C_2H_4CH_3$), 33.5 (C-5), 36.1, 36.4, 36.77, 36.80 (C-8, C-3′, C-1″, C-2 olean), 40.3 (C-5′), 45.8 (C-2 olivo), 48.3 (2′-OCH_3), 55.7, 58.8, 59.0 (3×OCH_3), 66.9 (C-5 olivo), 67.9 (C-9), 69.3 (C-6′), 72.9 (C-6), 73.1 (C-5 olean), 73.8 (C-4′), 75.0 (C-2″), 75.4 (C-10), 75.6 (C-3″), 76.1 (C-3 olivo), 77.5 (C-4 olean), 81.8 (C-3 olean), 82.2 (C-7), 85.4 (C-4 olivo), 97.2 (C-1 olivo.), 101.1 (C-1 olean), 103.1 (C-2′), 138.4 (C-2), 141.5 (C-3); IR (film): $\tilde{\nu}$=3461 (brs), 2980 (s), 2957 (s), 2873 (s), 2848 (s), 1461 (s), 1378 (s), 1244 (s), 1193 (s), 1119 (s), 874 (s), 837 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{67}H_{136}O_{15}Si_3SnNa$: 1407.8107; found 1407.8069 $[M+Na]^+$.

(2*E*,4*E*,6*E*,10*E*,12*E*,8*R*,9*R*,16*S*,17*S*,19*S*,20*R*,2′*R*,3′*R*,4′*S*,5′*R*,6′*R*,2″*R*)-20-[6′-{2″-(4-*O*-(4-*O*-*tert*-butyldimethylsilyl-3-*O*-methyl-β-D-oleandropyranosyl)-3-*O*-triethylsilyl-L-olivomycopyranosyl)-3″-methoxypropyl}-4′-triethylsilyoxy-2′-methoxy-3′,5′-dimethyl-2′,3′,5′,6′-tetrahydro-4*H*-pyran-2′-yl]-7-[6-deoxy-4-*O*-methyl-2,3-*O*-di(triethylsilyl)-α-L-glucopyranosyl]-16,19,20-trihydroxy-17-methoxy-2,4,6,8,12-pentamethyl-2,4,6,10,12-eicosapentaene acid (54): *Cross-coupling:* Alkenyl stannane **52** (95 mg, 69 μmol) and alkenyl iodide **43** (72 mg, 89 μmol) were combined and azeotroped with toluene (3×5 mL). After drying under high vacuum for 1 h, the mixture was dissolved in *N*-methylpyrrolidinone (1.5 mL) and was degassed by FTP (freeze thaw process). The solution was cooled to −5°C, CuTC (40 mg, 0.21 mmol) was added and the mixture was allowed to warm to 0°C within 90 min. MTBE (5 mL) was added, the mixture was filtered over a pad of Celite and washed with MTBE (30 mL). The solvents were removed in vacuo and the residue was azeotroped with toluene (3×6 mL). The residue was dissolved in Et_2O (2 mL) and 1 M KF (2 mL) was added. After 2.5 h the mixture was filtered over pad of celite and washed with Et_2O (40 mL). The organic layer was washed with brine (10 mL), dried with Na_2SO_4 and concentrated. The residue was purified by flash chromatography (10 g silica gel, pentane/MTBE 1:1→1:3→1:5) to yield coupling product **53** (109 mg, 61.5 μmol, 89%) as a colorless foam. The cyanomethyl ester was used directly for the following ester hydrolysis.

Ester hydrolysis: To cyanomethyl ester **53** (100 mg, 56.4 mmol) in THF (3.9 mL) and water (1.3 mL) was added at 0°C LiOH·H_2O (7.0 mg, 0.17 mmol). After 3 h at 20°C the reaction was quenched by addition of phosphate buffer (5 mL, 1 M, pH 7). The aqueous layer was extracted with AcOEt (4×20 mL). The combined organic layers were washed with brine (20 mL) and dried with Na_2SO_4. Chromatography (10 g silica gel, pentane/MTBE 1:1 → 1:7) gave trihydroxy acid **54** (85 mg, 49 mmol, 88%) as a colorless oil. R_f=0.59 ($CHCl_3$/MeOH 10:1); $[\alpha]_D^{20}=-5.4$ (c=0.70, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ=0.13, 0.22 (2s, 6H, $SiCH_3$),

0.56–0.65 (m, 12H, SiCH_2CH$_3$), 0.71 (q, J=8.0 Hz, 6H, SiCH_2CH$_3$), 0.89 (q, J=8.2 Hz, 6H, SiCH_2CH$_3$), 0.97–1.04 (m, 27H, SiC(CH$_3$)$_3$, 2× SiCH$_2$CH_3), 1.08 (t, J=8.0 Hz, SiCH$_2$CH_3), 1.13 (d, J=6.8 Hz, 3H, 5′-CH$_3$), 1.15–1.22 (m, 12H, SiCH$_2$CH_3, 8-CH$_3$), 1.38 (d, J=6.3 Hz, 3H, 6-H$_3$ gluco), 1.40 (d, J=6.3 Hz, 3H, 3′-CH$_3$), 1.41 (d, J=5.8 Hz, 3H, 6-H$_3$ olean), 1.49–1.58 (m, 2H, 15-H$_2$), 1.62–1.75 (m, 2H, 1″-H, 2-H olean), 1.64 (s, 3H, 6-CH$_3$), 1.70 (d, J=6.1 Hz, 3H, 6-H$_3$ olivo), 1.73 (s, 3H, 3-CH$_3$ olivo), 1.76–1.90 (m, 2H, 18-H, 5′-H), 1.86 (s, 3H, 12-CH$_3$), 1.88 (s, 3H, 4-CH$_3$), 1.92–2.02 (m, 3H, 18-H, 1″-H, 2-H olivo), 2.09 (s, 3H, 2-CH$_3$), 2.13 (d, J=13.0 Hz, 1H, 2-H olivo), 2.23–2.34 (m, 1H, 14-H), 2.40–2.51 (m, 2H, 14-H, 3′-H), 2.60 (ddd, J=12.2, 4.6, 1.1 Hz, 1H, 2-H olean), 2.70 (t, J=9.1 Hz, 1H, 4-H gluco), 2.78–2.87 (m, 1H, 8-H), 3.12, 3.14 (2s, 6H, OCH$_3$), 3.16–3.24 (m, 1H, 3-H olean), 3.30 (2×s, 6H, OCH$_3$), 3.28–3.34 (m, 1H, 4-H olean.), 3.36 (s, 3H, OCH$_3$), 3.38–3.44 (m, 3H, 17-H, 3″-H, 5-H olean), 3.48 (dd, J=9.4, 4.4 Hz, 1H, 3″-H), 3.52–3.58 (m, 1H, 16-H), 3.66 (d, J=2.3 Hz, 1H, 20-H), 3.70 (dd, J=9.3, 3.3 Hz, 1H, 2-H gluco), 3.75 (d, J=9.8 Hz, 1H, 4-H olivo.), 3.92–4.00 (m, 2H, 2″-H, 5-H gluco), 4.01–4.14 (m, 4H, 4′-H, 6′-H, 9-H, 5-H olivo.), 4.22 (t, J=9.0 Hz, 1H, 3-H gluco), 4.26–4.32 (m, 1H, 19-H), 5.03 (d, J=3.1 Hz, 1H, 1-H gluco), 5.06 (d, J=4.0 Hz, 1H, 1-H olivo.), 5.13 (dd, J=9.8, 1.1 Hz, 1H, 1-H olean), 5.32 (d, J=9.5 Hz, 1H, 7-H), 5.50–5.58 (m, 2H, 10-H, 13-H), 5.96 (s, 1H, 5-H), 6.34 (d, J=15.8 Hz, 1H, 11-H), 7.50 (s, 1H, 3-H); ^{13}C NMR (125.8 MHz, C$_6$D$_6$): δ=−4.6, −3.6 (SiCH$_3$), 5.5, 5.6 (2× SiCH$_2$CH$_3$), 5.8 (5′-CH$_3$), 5.9 (SiCH$_2$CH$_3$), 7.25 (2×SiCH$_2$CH$_3$), 7.3 (SiCH$_2$CH$_3$), 7.36, 7.44 (2×SiCH$_2$CH$_3$), 12.4 (12-CH$_3$), 12.5 (3′-CH$_3$), 14.1 (2-CH$_3$), 17.3, 17.4 (8-CH$_3$, 6-CH$_3$), 18.4 (4-CH$_3$), 18.6 (SiC(CH$_3$)$_3$), 18.7, 18.85, 18.94 (C-6 gluco, C-6 olean., C-6 olivo.), 23.9 (3-CH$_3$ olivo.), 25.2 (C-14), 26.3 (SiC(CH$_3$)$_3$), 33.3 (C-15), 36.3, 36.4 (C-18, C-2 olean.), 36.8 (C-3′), 37.0 (C-1″), 38.8 (C-8), 40.4 (C-5′), 45.8 (C-2 olivo), 48.5 (2′-OCH$_3$), 55.7, 58.9, 59.2, 61.0 (OCH$_3$), 67.0 (C-5 olivo), 67.8 (C-19), 67.9 (C-5 gluco), 69.3 (C-6′), 72.9 (C-16), 73.1 (C-5 olean), 73.9 (C-4′), 74.8 (2C, (C-2, C-3)-gluco), 75.1 (C-2″), 75.4 (C-20), 75.6 (C-3″), 76.1 (C-3 olivo), 77.5 (C-4 olean), 80.5 (C-9), 81.8 (C-3 olean), 82.3 (C-17), 85.4 (C-4 olivo), 87.9 (C-4 gluco), 95.2 (C-1 gluco), 97.4 (C-1 olivo), 101.1 (C-1 olean.), 103.2 (C-2′), 124.5 (C-10), 125.4 (C-2), 132.0, 132.5, 133.2 (C-4, C-6, C-12), 134.0 (C-13), 135.0 (C-7), 140.1 (C-5), 140.6 (C-11), 146.0 (C-3), 173.3 (C-1); IR (film): $\tilde{\nu}$=3456 (brs), 2981 (s), 2958 (s), 2875 (s), 2853 (s), 1680 (s), 1462 (s), 1380 (s), 1241 (s), 1067 (s), 1003 (s), 874 (s), 841 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{89}H_{170}O_{22}Si_5K$: 1770.0667; found 1770.0673 $[M+K]^+$.

4‴-*O*-*tert*-Butyldimethylsilyl-21-*O*-methyl-23*O*,2′*O*,3′*O*,3″*O*-tetrakis(triethylsilyl)apoptolidin A (55): Et$_3$N (2.29 mL, 2.1 mmol) and 2,4,6-trichlorobenzoyl chloride (0.16 mL, 1 mmol) were added subsequently at 0°C to trihydroxycarboxylic acid **54** (85 mg, 49 μmol) dissolved in THF (6 mL). After 5 h at 20°C, toluene (6 mL) was added. This solution was added within 1 h to DMAP (508 mg, 4.2 mmol) in toluene (150 mL). The reaction mixture was stirred for 18 h at 20°C. NH$_4$Cl (60 mL) was added. The aqueous layer was extracted with MTBE (3×50 mL). The combined organic layers were washed with NaHSO$_4$ (50 mL; 1M), NaHCO$_3$ (50 mL), and brine (50 mL) and dried with MgSO$_4$. Chromatography (10 g silica gel, cyclohexane/AcOEt 5:1→2:1) gave macrolactone **55** (52 mg, 30 μmol, 62%) as a colorless oil. Further elution of the column with CH$_2$Cl$_2$/MeOH 20:1 provided recovered starting material **54** (11 mg, 6.4 μmol, 13%). R_f=0.44 (*n*-hexane/MTBE 1:1); $[\alpha]_D^{20}$=−41.1 (c=0.85, CHCl$_3$); ^{1}H NMR (500 MHz, C$_6$D$_6$): δ=0.12, 0.21 (2s, 6H, SiCH$_3$), 0.55–0.63 (m, 12H, SiCH_2CH$_3$), 0.71 (q, J=7.8 Hz, 6H, SiCH_2CH$_3$), 0.91 (q, J=7.8 Hz, 6H, SiCH_2CH$_3$), 0.95–1.03 (m, 27H, SiC(CH$_3$)$_3$, 2× SiCH$_2$CH_3), 1.06 (t, J=7.8 Hz, SiCH$_2$CH_3), 1.18 (t, J=7.8 Hz, SiCH$_2$CH_3), 1.22 (d, J=6.6 Hz, 3H, 8-CH$_3$), 1.28 (d, J=6.9 Hz, 3H, 24-CH$_3$), 1.41–1.51 (m, 2H, 15-H$_2$), 1.41 (d, J=5.9 Hz, 3H, 6‴-H$_3$), 1.42 (d, J=6.0 Hz, 3H, 6′-CH$_3$), 1.53 (d, J=6.7 Hz, 3H, 22-H$_3$), 1.58 (s, 3H, 6-CH$_3$), 1.63–1.78 (m, 2H, 26-H, 2‴-H), 1.69 (s, 3H, 12-CH$_3$), 1.71 (d, J=6.5 Hz, 3H, 6″-H$_3$), 1.75 (s, 3H, 3″-CH$_3$), 1.80 (s, 3H, 4-CH$_3$), 1.84–1.91 (m, 1H, 24-H), 1.98 (dd, J=12.7, 4.8 Hz, 1H, 2″-H), 2.02–2.16 (m, 3H, 14-H, 26-H, 2″-H), 2.11 (s, 3H, 2-CH$_3$), 2.20–2.29 (m, 2H, 18-H, 22-H), 2.34 (dd, J=14.3, 8.5 Hz, 1H, 18-H), 2.43 (d, J=4.3 Hz, 1H, 20-OH), 2.50–2.57 (m, 1H, 14-H), 2.60 (ddd, J=12.6, 4.8, 1.5 Hz, 1H, 2‴-H), 2.66–2.74 (m, 1H, 8-H), 2.73 (t, J=9.0 Hz, 1H, 4′-H), 3.04 (dd, J=8.4, 5.7 Hz, 1H, 17-H), 3.12, 3.13 (2×s, 6H, OCH$_3$), 3.20 (ddd, J=11.6, 8.3, 4.8 Hz, 1H, 3‴-H), 3.26 (2s, 6H, OCH$_3$), 3.32 (t, J=8.6 Hz, 1H, 4‴-H), 3.35 (s, 3H, OCH$_3$), 3.38–3.44 (m, 1H, 5‴-H), 3.45–3.55 (m, 3H, 16-H, 28-H$_2$), 3.73 (dd, J=9.3, 3.5 Hz, 1H, 2′-H), 3.76 (d, J=9.9 Hz, 1H, 4″-H), 3.89 (t, J=4.7 Hz, 1H, 20-H), 3.96 (dd, J=9.1, 9.8 Hz, 1H, 9-H), 3.95–4.01 (m, 1H, 27-H), 4.01–4.06 (m, 1H, 5′-H), 4.08–4.15 (m, 3H, 23-H, 25-H, 5″-H), 4.28 (t, J=9.1 Hz, 1H, 3′-H), 5.02–5.06 (m, 2H, 7-H, 1″-H), 5.08 (d, J=3.4 Hz, 1H, 1′-H), 5.13 (dd, J=9.7, 1.7 Hz, 1H, 1‴-H), 5.32 (dd, J=15.7, 9.1 Hz, 1H, 10-H), 5.53–5.59 (m, 1H, 13-H), 5.89–5.95 (m, 1H, 19-H), 6.12 (d, J=15.6 Hz, 1H, 11-H), 6.18 (s, 1H, 5-H), 7.56 (s, 1H, 3-H); ^{13}C NMR (125.8 MHz, C$_6$D$_6$): δ=−4.6, −3.6 (SiCH$_3$), 5.4, 5.6 (2× SiCH$_2$CH$_3$), 5.9 (2C, 24-CH$_3$, SiCH$_2$CH$_3$), 7.2, 7.26, 7.30, 7.36, 7.43 (4× SiCH$_2$CH$_3$, SiCH$_2$CH$_3$), 11.7, 11.8 (12-CH$_3$, 22-CH$_3$), 14.2 (2-CH$_3$), 16.0 (6-CH$_3$), 17.4 (4-CH$_3$), 18.4 (8-CH$_3$), 18.6 (SiC(CH$_3$)$_3$), 18.7, 18.9 (C-6′, C-6‴), 19.0 (C-6″), 23.9 (3″-CH$_3$), 25.0 (C-14), 26.3 (SiC(CH$_3$)$_3$), 34.8 (C-15), 35.7 (C-26), 36.4 (C‴-2), 37.2 (C-22), 38.2, 38.3 (C-8, C-18), 40.4 (C-24), 45.8 (C-2″), 47.8 (21-OCH$_3$), 55.6, 58.8, 60.3, 61.0 (OCH$_3$), 66.9 (C-5″), 67.9 (C-5′), 69.4 (C-25), 72.2 (C-19), 73.1 (C-5‴), 73.3 (C-23), 74.1 (C-16), 74.75, 74.82, 74.91 (C-2′, C-3′, C-27), 75.6 (C-28), 75.9 (C-20), 76.2 (C-3″), 77.5 (C-4‴), 81.8 (C-3‴), 82.3 (C-17), 82.6 (C-9), 85.5 (C-4″), 87.9 (C-4′), 95.8 (C-1′), 97.0 (C-1″), 101.1 (C-1‴), 102.2 (C-21), 124.1 (C-2), 125.6 (C-10), 132.1, 132.4, 133.5 (C-4, C-6, C-12), 133.3 (C-13), 140.5 (C-11), 141.2 (C-7), 144.9 (C-5), 146.0 (C-3), 169.8 (C-1); IR (film): $\tilde{\nu}$=3500 (brm), 2979 (s), 2955 (s), 2931 (s), 2852 (s), 1702 (s), 1460 (s), 1382 (s), 1241 (s), 1169 (s), 1115 (s), 1070 (s), 841 (s), 761 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{89}H_{168}O_{21}Si_5Na$: 1736.0822; found 1736.0889 $[M+Na]^+$.

21-*O*-Methylapoptolidin A (56): A HF·pyridine stock solution was prepared by mixing at 0°C HF·pyridine (0.8 mL, 70% HF), THF (10 mL) and pyridine (4 mL). To macrolactone **55** (24 mg, 14 μmol) in THF (4 mL) was added at 0°C an aliquot of the HF·pyridine stock solution (3 mL). After 24 h at 20°C, the reaction mixture was cooled to 0°C and an aliquot of the HF·pyridine stock solution (0.5 mL) was added. This addition was repeated daily. After 6 d, NaHCO$_3$ (10 mL) was added. The aqueous layer was extracted with AcOEt (4×15 mL). The combined organic layers were washed subsequently with NaHSO$_4$ (2×15 mL, 0.5M), NaHCO$_3$ (10 mL), and brine (20 mL) and dried with MgSO$_4$. Chromatography (2 g silica gel, CH$_2$Cl$_2$/MeOH 20:1, TLC control: MTBE/AcOEt/CH$_2$Cl$_2$/MeOH 4:4:4:1) gave 21-*O*-methylapoptolidin (**56**) (6.0 mg, 5.2 μmol, 38%). R_f=0.15 (MTBE/AcOEt/CH$_2$Cl$_2$/MeOH 4:4:4:1); HPLC: t_R=13.6 min (Dynamax C18, A: H$_2$O, B: MeOH, 70→100% B in 25 min, 0.7 mL min^{-1}, 30°C); $[\alpha]_D^{20}$=−76 (c=0.55, CHCl$_3$); ^{1}H NMR (500 MHz, CD$_3$OD): δ=0.93 (d, J=7.1 Hz, 3H, 24-CH$_3$), 1.11 (d, J=6.6 Hz, 3H, 22-CH$_3$), 1.14 (d, J=6.6 Hz, 3H, 8-CH$_3$), 1.22 (d, J=6.4 Hz, 3H, 6″-H$_3$), 1.25 (d, J=6.2 Hz, 3H, 6′-H$_3$), 1.28 (d, J=6.2 Hz, 3H, 6‴-H$_3$), 1.24–1.37 (m, 2H, 15-H, 2‴-H), 1.35 (s, 3H, 3″-CH$_3$), 1.40–1.47 (m, 1H, 15-H), 1.58 (ddd, J=14.7, 7.3, 3.2 Hz, 1H, 26-H), 1.67 (s, 3H, 12-CH$_3$), 1.73–1.86 (m, 4H, 22-H, 24-H, 26-H, 2″-H), 1.87–1.94 (m, 3H, 2″-H, 18-H$_2$), 1.90 (s, 3H, 6-CH$_3$), 1.94–2.03 (m, 1H, 14-H), 2.08 (s, 3H, 2-CH$_3$), 2.14 (s, 3H, 4-CH$_3$), 2.44 (ddd, J=12.2, 5.0, 1.9 Hz, 1H, 2‴-H), 2.47–2.54 (m, 1H, 14-H), 2.64–2.69 (m, 1H, 17-H), 2.72 (t, J=9.2 Hz, 1H, 4′-H), 2.68–2.79 (m, 1H, 8-H), 2.97 (t, J=9.1 Hz, 1H, 4‴-H), 3.14–3.24 (m, 2H, 3‴-H, 5‴-H), 3.25 (s, 3H, OCH$_3$), 3.34 (d, J=9.6 Hz, 1H, 4″-H), 3.34–3.37 (m, 1H, 16-H), 3.39 (dd, J=9.7, 3.8 Hz, 1H, 2′-H), 3.43, 3.44 (2s, 6H, OCH$_3$), 3.47 (dd, J=10.1, 5.0 Hz, 1H, 28-H), 3.53 (dd, J=10.1, 4.6 Hz, 1H, 28-H), 3.58 (s, 3H, OCH$_3$), 3.68–3.77 (m, 5H, 20-H, 23-H, 3′-H, 5′-H, 5″-H), 3.78–3.88 (m, 3H, 9-H, 25-H, 27-H), 4.81 (d, J=3.9 Hz, 1H, 1′-H), 4.82–4.85 (1H, 1‴-H, covered by H$_2$O signal), 4.95 (d, J=4.1 Hz, 1H, 1″-H), 5.16 (d, J=10.5 Hz, 1H, 7-H), 5.22 (dd, J=15.8, 9.2 Hz, 1H, 10-H), 5.46–5.52 (m, 1H, 19-H), 5.63 (dd, J=9.9, 6.6 Hz, 1H, 13-H), 6.12 (s, 1H, 5-H), 6.15 (d, J=15.8 Hz, 1H, 11-H), 7.28 (s, 1H, 3-H); ^{13}C NMR (125.8 MHz, CD$_3$OD): δ=5.8 (24-CH$_3$), 11.5 (22-CH$_3$), 12.0 (12-CH$_3$), 14.3 (2-CH$_3$), 16.7 (6-CH$_3$), 18.0 (4-CH$_3$), 18.25, 18.32, 18.35 (8-CH$_3$, C-6′, C-6‴), 18.9 (C-6″), 22.9 (3″-CH$_3$), 25.2 (C-14), 36.0, 36.1 (C-15, C-26), 37.18, 37.24 (C-22, C-2‴), 38.9 (C-8), 39.5 (C-18), 40.4 (C-24), 45.5 (C-2″), 48.1 (21-OCH$_3$), 57.3, 59.4, 60.96, 61.04 (4×OCH$_3$), 67.6 (C-5″), 68.2 (C-5′), 70.2 (C-25), 72.7 (C-19), 73.1 (C-3″), 73.2 (2C, C-23, C-5‴), 73.7 (C-2′), 74.9 (C-3′), 75.5, 75.6 (C-16, C-20), 75.9 (C-27), 76.6 (C-28), 77.2 (C-4‴), 82.0 (C-3‴), 83.5 (C-17), 84.5 (C-9), 85.9 (C-4″), 87.5 (C-4′), 96.2 (C-1′), 98.0 (C-1″), 101.9 (C-1‴), 102.9 (C-21), 124.9 (C-2), 126.3 (C-10), 133.0, 132.3 (C-4, C-6), 133.5 (C-13), 134.5 (C-12), 141.3

(C-11), 141.6 (C-7), 145.0 (C-5), 147.1 (C-3), 170.7 (C-1); IR (film): $\tilde{\nu}$= 3445 (brs), 2974 (s), 2829 (s), 1699 (s), 1455 (s), 1386 (s), 1247 (s), 1081 (s), 1014 (s), 968 (s), 846 (m), 736 cm^{-1} (s); HR-MS (ESI): *m/z*: calcd for $C_{59}H_{98}O_{21}Na$: 1165.6498; found 1165.6470 $[M+Na]^+$.

Apoptolin A (1) and 27-hydroxy apoptolidin A (57): H_2SiF_6 (3×100 μL, aq 25–30%) was added at −40°C to macrolactone **55** (41 mg, 24 μmol) in CH_3CN (8 mL). After 2 d at −35 to −25°C, further H_2SiF_6 (150 μL, aq 25–30%) was added and the reaction mixture was stirred for 24 h at −25 to −15°C. Then, the reaction mixture was stirred for 24 h at −15 to −5°C. Phosphate buffer (25 mL, pH 7, 1 M) was added. The aqueous layer was extracted with $CHCl_3$/*i*PrOH (5×15 mL, 5:1). The combined org. layers were dried with Na_2SO_4. Chromatography (6 g neutral silica gel, CH_2Cl_2/MeOH 20:1→15:1→10:1) gave apoptolidin A (**1**) (19 mg, 17 μmol, 71%) as a white solid. In addition, 27-hydroxy apoptolidin A (**57**) (5.5 mg, 6.5 μmol, 27%) was isolated. Apoptolidin A (**1**): M.p. 129–131°C (MeOH); R_f=0.12 ($CHCl_3$/MeOH 8:1); HPLC: t_R=14.3 min (Dynamax C18, A: H_2O, B: MeOH, 70→100% B in 25 min, 0.7 mL min^{-1}, 30°C); $[\alpha]_D^{21}$=−4.4 (*c*=0.70, MeOH); ^{1}H NMR (500 MHz, CD_3OD): δ= 0.90 (d, *J*=6.7 Hz, 3H, 24-CH_3), 1.04 (d, *J*=6.6 Hz, 3H, 22-CH_3), 1.17 (d, *J*=6.4 Hz, 3H, 8-CH_3),1.25 (d, *J*=6.1 Hz, 3H, 6″-H$_3$), 1.29 (d, *J*=6.3 Hz, 3H, 6′-H$_3$), 1.31 (d, *J*=6.1 Hz, 3H, 6‴-H$_3$), 1.27–1.37 (m, 1H, 2‴-H), 1.35 (s, 3H, 3″-CH_3), 1.40–1.57 (m, 3H, 15-H$_2$, 26-H), 1.58–1.65 (m, 1H, 26-H), 1.71 (s, 3H, 12-CH_3), 1.73–1.84 (m, 2H, 24-H, 18-H), 1.83 (dd, *J*= 13.5, 4.2 Hz, 1H, 2″-H), 1.92–1.99 (m, 1H, 2″-H), 1.96 (s, 3H, 6-CH_3), 2.04–2.24 (m, 3H, 14-H, 18-H, 22-H), 2.14 (s, 3H, 2-CH_3), 2.21 (s, 3H, 4-CH_3), 2.43–2.56 (m, 2H, 14-H, 2‴-H), 2.72–2.84 (m, 2H, 17-H, 8-H), 2.75 (t, *J*=9.1 Hz, 1H, 4′-H), 3.00 (t, *J*=8.9 Hz, 1H, 4‴-H), 3.14–3.27 (m, 2H, 3‴-H, 5‴-H), 3.30 (s, 3H, 28-OCH_3), 3.33–3.51 (m, 5H, 28-H$_2$, 4″-H, 16-H, 27-H), 3.42 (dd, *J*=9.7, 3.8 Hz, 1H, 2′-H), 3.39 (s, 3H, 17-OCH_3), 3.45 (s, 3H, 3‴-OCH_3), 3.56 (d, *J*=0.9 Hz, 1H, 20-H), 3.61 (s, 3H, 4′-OCH_3), 3.67–3.81 (m, 4H, 23-H, 3′-H, 5′-H, 5″-H), 3.86 (t, *J*=9.2 Hz, 1H, 9-H), 3.96–4.02 (m, 1H, 25-H), 4.83–4.89 (2H,1′-H, 1‴-H, overlaid by H_2O signal), 4.97 (d, *J*=3.7 Hz, 1H, 1″-H), 5.26 (d, *J*=9.8 Hz, 1H, 7-H), 5.26 (dd, *J*=15.8, 9.2 Hz, 1H, 10-H), 5.32 (d, *J*=11.3 Hz, 1H, 19-H), 5.71 (t, *J*=7.2 Hz, 1H, 13-H), 6.21 (d, *J*=16.0 Hz, 1H, 11-H), 6.22 (s, 1H, 5-H), 7.41 (s, 1H, 3-H); ^{13}C NMR (125.8 MHz, CD_3OD): δ=5.2 (24-CH_3), 12.0 (12-CH_3), 12.2 (22-CH_3), 14.2 (2-CH_3), 16.5 (6-CH_3), 17.9 (4-CH_3), 18.2 (8-CH_3), 18.3 (2C, C-6′, C-6‴), 18.9 (C-6″), 22.8 (3″-CH_3), 24.7 (C-14), 36.4, 36.5 (C-15, C-22), 37.2 (2C, C-26, C-2‴), 38.4 (C-18), 39.0 (C-8), 40.7 (C-24), 45.5 (C-2″), 57.3 (3‴-OCH_3), 59.5 (28-OCH_3), 60.9 (4′-OCH_3), 61.3 (17-OCH_3), 67.5 (C-5″), 68.2 (C-5′), 69.4 (C-25), 72.5 (C-19), 73.0 (C-3″), 73.2 (C-5‴), 73.7 (C-2′), 73.9 (C-23), 74.7 (C-16), 75.0 (C-3′), 75.5 (C-20), 76.8, 76.9 (C-27, C-28), 77.2 (C-4‴), 82.0 (C-3‴), 83.8 (C-17), 84.3 (C-9), 85.9 (C-4″), 87.5 (C-4′), 96.1 (C-1′), 99.5 (C-1″), 101.3 (C-21), 101.9 (C-1‴), 123.9 (C-2), 126.4 (C-10), 133.1 (C-4), 133.3 (C-13), 133.5 (C-6), 134.8 (C-12), 141.2 (C-11), 142.8 (C-7), 146.9 (C-5), 149.2 (C-3), 172.7 (C-1); IR (film): $\tilde{\nu}$=3416 (brs), 2976 (s), 2934 (s), 1666 (s), 1599 (s), 1454 (s), 1387 (s), 1256 (s), 1080 (s), 1027 (s), 969 (s), 667 cm^{-1} (s); HR-MS (ESI): *m/z*: calcd for $C_{58}H_{96}O_{21}Na$: 1151.6342; found 1151.6307 $[M+Na]^+$.

27-Hydroxy apoptolidin A (57): R_f=0.27 ($CHCl_3$/MeOH 8:1); HPLC: t_R=8.2 min (Dynamax C18, A: H_2O, B: MeOH, 70→100% B in 25 min, 0.7 mL min^{-1}, 30°C); $[\alpha]_D^{21}$ = +3.8 (*c*=1.05, $CHCl_3$); ^{1}H NMR (500 MHz, CD_3OD): δ=0.91 (d, *J*=6.9 Hz, 3H, 24-CH_3), 1.06 (d, *J*=6.6 Hz, 3H, 22-CH_3), 1.16 (d, *J*=6.6 Hz, 3H, 8-CH_3), 1.29 (d, *J*=6.2 Hz, 6′-H$_3$), 1.30–1.36 (m, 1H, 26-H), 1.40–1.49 (m, 1H, 15-H), 1.50–1.59 (m, 1H, 15-H), 1.61 (ddd, *J*=14.1, 8.8, 2.6 Hz, 1H, 26-H), 1.71 (s, 3H, 12-CH_3), 1.73–1.84 (m, 2H, 18-H, 24-H), 1.96 (s, 3H, 6-CH_3), 2.03–2.24 (m, 3H, 14-H, 18-H, 22-H), 2.14 (s, 3H, 2-CH_3), 2.22 (s, 3H, 4-CH_3), 2.45–2.54 (m, 1H, 14-H), 2.72–2.83 (m, 2H, 8-H, 17-H), 2.75 (t, *J*=9.3 Hz, 1H, 4′-H), 3.20 (dd, *J*= 9.5, 6.3 Hz, 1H, 28-H), 3.24 (dd, *J*=9.4, 4.6 Hz, 1H, 28-H), 3.33 (s, 3H, 28-OCH_3), 3.39 (s, 3H, 17-OCH_3), 3.43 (dd, *J*=9.7, 3.8 Hz, 1H, 2′-H), 3.45–3.50 (m, 1H. 16-H), 3.55–3.63 (m, 2H, 20-H, 27-H), 3.61 (s, 3H; 4′-OCH_3), 3.75 (t, *J*=9.3 Hz, 1H, 3′-H), 3.74–3.81 (m, 2H, 23-H, 5′-H), 3.86 (dd, *J*=9.3, 9.3 Hz, 1H, 9-H), 4.13 (ddd, *J*=8.8, 3.0, 2.2 Hz, 1H, 25-H), 4.84 (1H, 1′-H, below H_2O-Signal), 5.22–5.30 (m, 2H, 7-H, 10-H), 5.34 (d, *J*=11.2 Hz, 1H, 19-H), 5.72 (dd, *J*=9.2, 6.9 Hz, 1H, 13-H), 6.21 (d, *J*=15.6 Hz, 1H, 11-H), 6.22 (s, 1H, 5-H), 7.24 (s, 1H, 3-H); ^{13}C NMR (125.8 MHz, CD_3OD): δ=5.3 (24-CH_3), 12.0 (12-CH_3), 12.1 (22-CH_3), 14.0 (2-CH_3), 16.5 (6-CH_3), 17.8 (4-CH_3), 18.2, 18.3 (8-CH_3, C-6′), 24.6 (C-14), 36.4 (2C, C-15, C-22), 38.4, 38.5 (C-18, C-26), 39.0 (C-8), 40.8 (C-24), 59.4 (28-OCH_3), 60.9 (4′-OCH_3), 61.3 (17-OCH_3), 68.15, 68.22 (C-27, C-5′), 69.2 (C-25), 72.4 (C-19), 73.7, 73.8 (C-23, C-2′), 74.6 (C-16), 75.0 (C-3′), 75.5 (C-20), 78.7 (C-28), 83.8 (C-17), 84.3 (C-9), 87.5 (C-4′), 96.1 (C-1′), 101.3 (C-21), 124.0 (C-2), 126.4 (C-10), 133.3 (C-13), 132.2, 133.4, 134.8 (C-4, C-6, C-12), 141.2 (C-11), 140.7 (C-7), 147.0 (C-5), 148.9 (C-3), 172.6 (C-1); IR (film): $\tilde{\nu}$=3416 (brs), 2978 (s), 2935 (s), 2842 (s), 1666 (s), 1598 (s), 1455 (s), 1389 (s), 1258 (s), 1084 (s), 1029 (s), 969 (s), 667 cm^{-1} (s); HR-MS (ESI): *m/z*: calcd for $C_{44}H_{72}O_{15}Na$: 863.4769; found 863.4769 $[M+Na]^+$.

(2*R*,3*R*,4*S*,5*R*,6*R*,1′*R*,2′*S*,4′*S*,2″*R*)-2-(1′,2′-Diacetoxy-5′-hydroxy-4′-methoxypentyl)-6-(2″-*tert*-butyldimethylsilyloxy-3″-methoxypropyl)-4-triethylsilyloxy-2-methoxy-3,5-dimethyl-2,3,5,6-tetrahydro-4*H*-pyran (58): *TBS protection:* Imidazol (0.57 g, 8.4 mmol), DMAP (51 mg, 0.40 mmol) and TBSCl (2.5 g, 8.4 mmol, 50% in toluene) were added subsequently at 0°C to alcohol **49** (1.04 g, 1.52 mmol) in CH_2Cl_2 (25 mL). The reaction mixture was stirred for 14 h at 20°C. The reaction was quenched by addition of MeOH (1 mL). $NaHCO_3$ (15 mL) and MTBE (30 mL) were added. The aqueous layer was extracted with MTBE (3×30 mL). The combined organic layers were washed with brine (10 mL) and dried with $MgSO_4$. Chromatography (160 g silica gel, pentane/MTBE 3:2) gave the corresponding TBS ether (724 mg, 0.922 mmol, 61%) and recovered starting material (395 mg, 0.577 mmol, 38%).

Benzyl ether cleavage: The benzylether (724 mg, 922 μmol, 96%) was dissolved in AcOEt/MeOH (5 mL, 1:1). Ammonium formiate (30 mg, 1.0 mmol) and $Pd(OH)_2$/C (150 mg, 245 μmol) were added at 20°C and the mixture was stirred under a hydrogen atmosphere of 1 bar. After 5 h, 50 mg of the catalyst was added and the mixture was stirred for further 2 h. AcOEt (10 mL) was added and the mixture was filtered over a pad of celite and the solvents were removed in vacuo. The residue was purified by chromatography (50 g silica gel, pentane/MTBE 1:1 → 1:10) to yield alcohol **58** (502 mg, 708 μmol, 77%) as a colorless oil. R_f=0.57 ($CHCl_3$/MeOH 9:1); $[\alpha]_D^{19}$=+47.9 (*c*=0.96, $CHCl_3$); ^{1}H NMR (400 MHz, C_6D_6): δ=0.12, 0.15 (2s, 6H, $SiCH_3$), 0.63 (q, *J*=7.9 Hz, 6H, $SiCH_2CH_3$), 1.00 (s, 9H, $SiC(CH_3)_3$), 1.01 (t, *J*=7.9 Hz, 9H, $SiCH_2CH_3$), 1.18 (d, *J*= 7.0 Hz, 3H, 5-CH_3), 1.51 (d, *J*=6.6 Hz, 3H, 3-CH_3), 1.56–1.64 (m, 1H, 1″-H), 1.65 (dd, *J*=6.9, 5.8 Hz, 1H, OH), 1.72–1.82 (m, 1H, 3′-H), 1.74, 1.79 (2s, 6H, OAc), 1.84–1.93 (m, 2H, 5-H, 1″-H), 2.20–2.30 (m, 1H, 3-H), 2.28–2.37 (m, 1H, 3′-H), 3.08 (s, 3H, OCH_3), 3.16–3.23 (m, 3H, 4′-H, 3″-H$_2$), 3.19, 3.32 (2s, 6H, OCH_3), 3.33–3.42 (m, 1H, 5′-H), 3.55–3.62 (m, 1H, 5′-H), 4.07–4.14 (m, 2H, 2″-H, 4-H), 4.16 (ddd, *J*=8.4, 2.5, 2.5 Hz, 1H, 6-H), 5.44 (d, *J*=5.1 Hz, 1H, 1′-H), 5.80 (dt, *J*=8.6, 4.5 Hz, 1H, 2′-H); ^{13}C NMR (100.6 MHz, C_6D_6): δ=−4.6, −3.4 ($SiCH_3$), 5.5 ($SiCH_2CH_3$), 5.6 (5-CH_3), 7.2 ($SiCH_2CH_3$), 11.7 (3-CH_3), 18.5 ($SiC(CH_3)_3$), 20.51, 20.54 (2×OAc), 26.2 ($SiC(CH_3)_3$), 35.8 (C-3′), 37.3 (C-3), 39.2 (C-1″), 40.6 (C-5), 48.2 (2-OCH_3), 57.5, 58.5 (2×OCH_3), 63.6 (C-5′), 69.3 (C-2′), 69.6 (C-6), 70.4 (C-4), 73.2 (C-1′), 73.8 (C-2″), 78.0, 78.5 (C-5′, C-3″), 101.5 (C-2), 169.4, 169.7 (OAc); IR (film): $\tilde{\nu}$=3465 (brs), 2988 (s), 2957 (s), 2878 (s), 2855 (s), 1754 (s), 1469 (s), 1416 (s), 1365 (s), 1256 (s), 1224 (s), 830 cm^{-1} (s); HR-MS (ESI): *m/z*: calcd for $C_{34}H_{68}O_{11}Si_2Na$: 731.4205; found 731.4198 $[M+Na]^+$.

(2*E*,6*S*,7*S*,9*S*,10*R*,2′*R*,3′*R*,4′*S*,5′*R*,6′*R*,2″*R*)-10-[6′-(2″-*tert*-Butyldimethylsilyloxy-3″-methoxypropyl)-4′-triethylsilyloxy-2′-methoxy-3′,5′-dimethyl-2′,3′,5′,6′-tetrahydro-4*H*-pyran-2′-yl]-6,9,10-trihydroxy-7-methoxy-2-tri-*n*-butyl stannyl-dec-2-ene (59): According to the procedure for the conversion of alcohol **50** into alkenyl stannane **52** (Dess–Martin oxidation, Grignard addition, acetate cleavage), alcohol **58** (482 mg, 0.682 mmol) was transformed into alkenyl stannane **59** (336 mg, 0.342 mmol, 48%). R_f=0.45 (MTBE/*n*-hexane 3:1); $[\alpha]_D^{19}$=+32.4 (*c*=1.53, $CHCl_3$); ^{1}H NMR (400 MHz, C_6D_6): δ=0.151, 0.154 (2s, 6H, $SiCH_3$), 0.63 (q, *J*=7.9 Hz, 6H, $SiCH_2CH_3$), 0.95 (t, *J*=7.3 Hz, 9H, $Sn(CH_2)_3CH_3$), 0.98–1.05 (m, 24H, $SiCH_2CH_3$, $SiC(CH_3)_3$, $SnCH_2C_3H_7$), 1.12 (d, *J*=6.9 Hz, 3H, 5′-CH_3), 1.35–1.44 (m, 9H, 3′-CH_3, $SnC_2H_4CH_2CH_3$), 1.54–1.71 (m, 9H, 1″-H, 5-H$_2$, $SnCH_2CH_2C_2H_5$), 1.76–1.91 (m, 3H, 1″-H, 5′-H, 8-H), 1.92–1.99 (m, 1H, 8-H), 2.01 (t, *J*(H,Sn)=23.8 Hz, 3H, 1-H$_3$), 2.15 (d, *J*=5.5 Hz, 1H, 6-OH), 2.37–2.57 (m, 4-H$_2$, 3′-H), 2.65 (d, *J*=5.5 Hz, 1H, 10-OH), 3.05–3.10 (brs, 1H, 9-OH), 3.08 (s, 3H, OCH_3), 3.14 (dd, *J*=9.4, 4.6 Hz,

1H, 3″-H), 3.18 (dd, J=9.4, 6.2 Hz, 1H, 3″-H), 3.28, 3.29 (2s, 6H, OCH_3), 3.43 (ddd, J=8.5, 4.5, 4.0 Hz, 1H, 7-H), 3.59–3.66 (m, 2H, 6-H, 10-H), 4.04–4.11 (m, 2H, 2″-H, 4′-H), 4.14–4.19 (m, 1H, 6′-H), 4.24–4.31 (m, 1H, 9-H), 5.73–5.93 (m, 1H, 3-H); ^{13}C NMR (100.6 MHz, C_6D_6): δ= −4.5, −3.6 ($SiCH_3$), 5.5 ($SiCH_2CH_3$), 5.7 (5′-CH_3), 7.2 ($SiCH_2CH_3$), 9.5 ($SnCH_2C_3H_7$), 12.5 (3′-CH_3), 13.9 ($Sn(CH_2)_3CH_3$), 18.5 ($SiC(CH_3)_3$), 19.4 (C-1), 25.3 (C-4), 26.2 ($SiC(CH_3)_3$), 27.8, 29.7 ($SnCH_2C_2H_4CH_3$), 33.4 (C-3′), 36.6 (C-3′), 37.8 (C-8), 39.4 (C-1″), 40.7 (C-5′), 48.5 (2′-OCH_3), 58.5, 59.1 (2×OCH_3), 67.8 (C-9), 69.4 (C-6′), 70.5 (C-4′), 73.0 (C-6), 74.0 (C-2″), 75.3 (C-10), 77.9 (C-3″), 82.1 (C-7), 103.1 (C-2′), 138.3 (C-2), 141.5 (C-3); IR (film): $\tilde{\nu}$=3440 (brs), 2959 (s), 2929 (s), 2876 (s), 2853 (s), 1465 (s), 1415 (s), 1381 (s), 1250 (s), 1149 (s), 1108 (s), 1069 (s), 1020 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{47}H_{98}O_9Si_2SnNa$: 1005.5669; found 1005.5699 $[M+Na]^+$.

Cyanomethyl-(2*E*,4*E*,6*E*,10*E*,12*E*,8*R*,9*R*,16*S*,17*S*,19*S*,20*R*,2′*R*,3′*R*,4′*S*,5′*R*,6′*R*,2″*R*)-20-[6′-{2″-*tert*-butyldimethylsilyloxy-3″-methoxypropyl}-4′-triethylsilyloxy-2′-methoxy-3′,5′-dimethyl-2′,3′,5′,6′-tetrahydro-4*H*-pyran-2′-yl]-9-[6-deoxy-4-*O*-methyl-2,3-*O*-bis(triethylsilyl)-α-L-glucopyranosyl]-16,19,20-trihydroxy-17-methoxy-2,4,6,8,12-pentamethyl eicosapenta-2,4,6,10,12-enoate (60): According to the cross-coupling procedure (**43** + **52** → **53**), alkenyl stannane **59** (62 mg, 60 μmol) and alkenyl iodide **43** (58 mg, 72 μmol) were transformed with CuTC (36 mg, 180 μmol) into cyanomethyl ester **60** (67 mg, 49 μmol, 82%). R_f=0.37 (*n*-hexane/MTBE 1:3); $[\alpha]_D^{19}$=+27.8 (c=0.83, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ=0.16 (s, 6H, $SiCH_3$), 0.64 (q, J=7.9 Hz, 6H, $SiCH_2CH_3$), 0.70 (q, J=7.9 Hz, 6H, $SiCH_2CH_3$), 0.84–0.91 (m, 6H, $SiCH_2CH_3$), 1.01 (s, 9H, $SiC(CH_3)_3$), 1.02 (t, J=7.9 Hz, 9H, $SiCH_2CH_3$), 1.07 (t, J=7.9 Hz, 9H, $SiCH_2CH_3$), 1.13 (d, J=6.9 Hz, 3H, 5′-CH_3), 1.17 (t, J=7.9 Hz, 9H, $SiCH_2CH_3$), 1.19 (d, J=6.6 Hz, 8-CH_3), 1.37 (d, J=6.2 Hz, 3H, 6-H_3 gluco), 1.40 (d, J=6.6 Hz, 3H, 3′-CH_3), 1.49–1.62 (m, 3H, 15-H_2, 1″-H), 1.67 (s, 3H, 6-CH_3), 1.72–1.96 (m, 4H, 1″-H, 5′-H, 18-H_2), 1.87 (brs, 6H, 12-CH_3, 4-CH_3), 1.93 (d, J=1.1 Hz, 3H, 2-CH_3), 2.07–2.17 (brs, 1H, 16-OH), 2.26–2.35 (m, 1H, 14-H), 2.39–2.52 (m, 2H, 14-H, 3′-H), 2.64 (d, J=5.5 Hz, 1H, 20-OH), 2.69 (t, J=9.2 Hz, 1H, 4-H gluco), 2.79–2.88 (m, 1H, 8-H), 2.97–3.10 (brs, 1H, 19-OH), 3.08 (s, 3H, OCH_3), 3.14 (dd, J=9.4, 4.6 Hz, 1H, 3″-H), 3.19 (dd, J=9.4, 6.2 Hz, 1H, 3″-H), 3.285, 3.293, 3.35 (3s, 9H, OCH_3), 3.34–3.39 (m, 1H, 17-H), 3.49–3.54 (m, 1H, 16-H), 3.61–3.64 (m, 1H, 20-H), 3.69 (dd, J=9.3, 3.3 Hz, 1H, 2-H gluco), 3.82 (s, 2H, OCH_2CN), 3.95 (dq, J=9.7, 6.2 Hz, 1H, 5-H gluco), 4.05–4.20 (m, 4H, 2″-H, 4′-H, 6′-H, 9-H), 4.21 (t, J=9.1 Hz, 1H, 3-H gluco), 4.25–4.30 (m, 1H, 19-H), 5.02 (d, J=3.4 Hz, 1H, 1-H gluco), 5.40 (d, J=9.9 Hz, 1H, 7-H), 5.51–5.60 (m, 2H, 10-H, 13-H), 5.95 (s, 1H, 5-H), 6.38 (d, J=15.6 Hz, 1H, 11-H), 7.24 (s, 1H, 3-H); ^{13}C NMR (125.8 MHz, C_6D_6): δ= −4.5, −3.6 ($SiCH_3$), 5.5, 5.6 (2×$SiCH_2CH_3$), 5.7 (5′-CH_3), 5.9 ($SiCH_2CH_3$), 7.2, 7.3 7.4 ($SiCH_2CH_3$), 12.4, 12.5 (12-CH_3, 3′-CH_3), 14.1 (2-CH_3), 17.2, 17.3 (8-CH_3, 6-CH_3), 18.3 (4-CH_3), 18.5 ($SiC(CH_3)_3$), 18.7 (C-6 gluco), 25.2 (C-14), 26.2 ($SiC(CH_3)_3$), 33.4 (C-15), 36.6 (C-3′), 37.2 (C-18), 38.8 (C-8), 39.4 (C-1″), 40.7 (C-5′), 48.1 (OCH_2CN), 48.5 (2′-OCH_3), 58.5, 59.3, 61.0 (OCH_3), 67.6 (C-19), 67.9 (C-5 gluco), 69.4 (C-6′), 70.4 (C-4′), 73.0 (C-16), 73.9 (C-2″), 74.8 (2C, (C-2, C-3)-gluco), 75.3 (C-20), 77.9 (C-3″), 80.3 (C-9), 82.2 (C-17), 87.9 (C-4 gluco), 95.1 (C-1 gluco), 103.1 (C-2′), 115.0 (OCH_2CN), 124.0 (C-2), 124.3 (C-10), 131.7, 132.4, 133.2 (C-4, C-6, C-12), 134.2 (C-13), 135.5 (C-7), 140.6 (C-5), 140.8 (C-11), 146.5 (C-3), 166.9 (C-1); IR (film): $\tilde{\nu}$=3490 (brs), 2956 (s), 2877 (s), 1723 (s), 1463 (s), 1413 (s), 1384 (s), 1241 (s), 1141 (s), 1106 (s), 1071 (s), 1006 (s), 968 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{71}H_{133}NO_{16}Si_4Na$: 1390.8599; found 1390.8638 $[M+Na]^+$.

27-*O*-*tert*-Butyldimethylsilyl-9-*O*-[6-deoxy-4-*O*-methyl-2,3-*O*-bis(triethylsilyl)-L-α-glucopyranosyl]-21-*O*-methyl-23-*O*-triethylsilyl-apoptolidinone A (61): *Ester hydrolysis:* Cyanomethyl ester **60** (51 mg, 49 mmol) dissolved in THF/H_2O (4 mL, 3:1) was hydrolyzed with LiOH monohydrate (5.0 mg, 0.11 mmol) according to the procedure (**53** → **54**). The corresponding trihydroxy acid (51 mg) was used without further purification for the following macrolactonization step. Analytical data of the acid: R_f=0.35 (CH_2Cl_2/MeOH 15:1); $[\alpha]_D^{19}$=+25.3 (c=1.23, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ=0.16 (s, 6H, $SiCH_3$), 0.65 (q, J=8.0 Hz, 6H, $SiCH_2CH_3$), 0.70 (q, J=7.9 Hz, 6H, $SiCH_2CH_3$), 0.89 (q, J=7.9 Hz, 6H, $SiCH_2CH_3$), 0.99–1.05 (m, 18H, $SiC(CH_3)_3$, $SiCH_2CH_3$), 1.07 (t, J=8.0 Hz, 9H, $SiCH_2CH_3$), 1.13 (d, J=6.8 Hz, 3H, 5′-CH_3), 1.15–1.21 (m, 12H, $SiCH_2CH_3$, 8-CH_3), 1.37 (d, J=6.1 Hz, 3H, 6-H_3 gluco), 1.41 (d, J=6.5 Hz, 3H, 3′-CH_3), 1.50–1.62 (m, 3H, 15-H_2, 1″-H), 1.65 (s, 3H, 6-CH_3), 1.73–1.99 (m, 4H, 1″-H, 5′-H, 18-H_2), 1.86 (s, 3H, 12-CH_3), 1.89 (s, 3H, 4-CH_3), 2.09 (s, 3H, 2-CH_3), 2.25–2.35 (m, 1H, 14-H), 2.40–2.53 (m, 2H, 14-H, 3′-H), 2.69 (t, J=9.2 Hz, 1H, 4-H gluco), 2.78–2.87 (m, 1H, 8-H), 3.09 (s, 3H, OCH_3), 3.13–3.24 (m, 1H, 3″-H_2), 3.30, 3.31, 3.35 (3s, 9H, OCH_3), 3.37–3.43 (m, 1H, 17-H), 3.50–3.57 (m, 1H, 16-H), 3.65 (s, 1H, 20-H), 3.70 (dd, J=8.7, 2.9 Hz, 1H, 2-H gluco), 3.92–4.00 (m, 1H, 5-H gluco), 4.06–4.14 (m, 3H, 2″-H, 4′-H, 9-H), 4.15.4.20 (m, 1H, 6′-H), 4.22 (t, J=9.1 Hz, 1H, 3-H gluco), 4.29 (d, J=9.9 Hz, 1H, 19-H), 5.03 (d, J=2.9 Hz, 1H, 1-H gluco), 5.35 (d, J=9.7 Hz, 1H, 7-H), 5.49–5.59 (m, 2H, 10-H, 13-H), 5.98 (s, 1H, 5-H), 6.36 (d, J=16.1 Hz, 1H, 11-H), 7.52 (s, 1H, 3-H); ^{13}C NMR (125.8 MHz, C_6D_6): δ= −4.5, −3.6 ($SiCH_3$), 5.5, 5.6 (2×$SiCH_2CH_3$), 5.7 (5′-CH_3), 5.9 ($SiCH_2CH_3$), 7.2, 7.3 7.4 ($SiCH_2CH_3$), 12.4, 12.5 (12-CH_3, 3′-CH_3), 14.0 (2-CH_3), 17.33, 17.35 (8-CH_3, 6-CH_3), 18.3 (4-CH_3), 18.5 ($SiC(CH_3)_3$), 18.7 (C-6 gluco), 25.2 (C-14), 26.2 ($SiC(CH_3)_3$), 33.4 (C-15), 36.6 (C-3′), 37.2 (C-18), 38.8 (C-8), 39.4 (C-1″), 40.7 (C-5′), 48.6 (2′-OCH_3), 58.6, 59.3, 61.0 (3×OCH_3), 67.7 (C-19), 67.9 (C-5 gluco), 69.4 (C-6′), 70.4 (C-4′), 73.0 (C-16), 74.0 (C-2″), 74.8 (2C, (C-2, C-3)-gluco), 75.3 (C-20), 77.9 (C-3″), 80.5 (C-9), 82.3 (C-17), 87.9 (C-4 gluco), 95.2 (C-1 gluco), 103.1 (C-2′), 124.4 (2C, C-2, C-10), 132.1, 132.5, 133.2 (C-4, C-6, C-12), 134.1 (C-13), 135.1 (C-7), 140.2 (C-5), 140.6 (C-11), 146.1 (C-3), 173.7 (C-1); IR (film): $\tilde{\nu}$=3445 (brs), 2985 (s), 2958 (s), 2876 (s), 2854 (s), 1708 (s), 1466 (s), 1415 (s), 1382 (s), 1242 (s), 1141 (s), 1111 (s), 1069 (s), 1005 (s), 969 (s), 845 (s), 747 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{69}H_{132}O_{16}Si_4Na$: 1351.8490; found 1351.8521 $[M+Na]^+$.

Macrolactonization: The trihydroxy acid (15 mg, 11 μmol), Et_3N (65 μL, 0.47 mmol), 2,4,6-trichlorobenzoyl chloride (35 μL, 0.23 mmol) in THF (1.5 mL) was added to DMAP (119 mg, 0.95 mmol) in toluene (35 mL) as described for the macrolactonization (**54** → **55**). After chromatography (5 g silica gel, cyclohexane/AcOEt 8:1 → 5:1) macrolactone **61** (10 mg, 7.6 μmol, 69%) was obtained as a colorless oil. R_f=0.51 (*n*-hexane/MTBE 1:1); $[\alpha]_D^{19}$= −19.1 (c=0.79, $CHCl_3$); ^{1}H NMR (400 MHz, C_6D_6): δ=0.16, 0.18 (2s, 6H, $SiCH_3$), 0.62 (q, J=8.0 Hz, 6H, $SiCH_2CH_3$), 0.71 (q, J=8.1 Hz, 6H, $SiCH_2CH_3$), 0.91 (q, J=8.1 Hz, 6H, $SiCH_2CH_3$), 0.97–1.09 (m, 27H, $SiC(CH_3)_3$), 2×$SiCH_2CH_3$), 1.18 (t, J=8.0 Hz, 9H, $SiCH_2CH_3$), 1.22 (d, J=6.9 Hz, 3H, 8-CH_3), 1.29 (d, J=6.6 Hz, 24-CH_3), 1.34–1.50 (m, 2H, 15-H_2), 1.42 (d, J=6.3 Hz, 3H, 6′-H_3), 1.53 (d, J=6.6 Hz, 3H, 22-CH_3), 1.57 (s, 3H, 6-CH_3), 1.61–1.98 (m, 3H, 26-H_2, 24-H), 1.69 (s, 3H, 12-CH_3), 1.80 (s, 3H, 4-CH_3), 1.99–2.35 (m, 5H, 18-H_2, 14-H, 22-H, 16-OH), 2.11 (s, 3H, 2-CH_3), 2.41 (brs, 1H, 20-OH), 2.48–2.63 (m, 1H, 14-H), 2.64–2.78 (m, 1H, 8-H), 2.73 (dd, J=9.1, 9.1 Hz, 1H, 4′-H), 2.98–3.08 (m, 1H, 17-H), 3.06 (s, 3H, 28-OCH_3), 3.15–3.23 (m, 2H, 28-H_2), 3.29 (21-OCH_3), 3.36 (17-OCH_3), 3.38 (4′-OCH_3), 3.45–3.54 (m, 1H, 16-H), 3.73 (dd, J=9.3, 3.4 Hz, 1H, 2′-H), 3.90 (brd, J=5.3 Hz, 1H, 20-H), 3.95 (t, J=9.1 Hz, 1H, 9-H), 4.03 (dq, J=9.6, 6.0 Hz, 1H, 5′-H), 4.10–4.18 (m, 2H, 23-H, 27-H), 4.18–4.23 (m, 1H, 25-H), 4.28 (t, J=9.0 Hz, 1H, 3′-H), 5.01 (d, J=10.0 Hz, 1H, 7-H), 5.07 (d, J=3.3 Hz, 1H, 1′-H), 5.32 (dd, J=15.7, 9.2 Hz, 1H, 10-H), 5.55 (dd, J=10.0, 6.2 Hz, 1H, 13-H), 5.89–5.97 (m, 1H, 19-H), 6.11 (d, J=15.8 Hz, 1H, 11-H), 6.15 (s, 1H, 5-H), 7.53 (s, 1H, 3-H); ^{13}C NMR (125.8 MHz, C_6D_6): δ= −4.5, −3.5 ($SiCH_3$), 5.5, 5.6 (2×$SiCH_2CH_3$), 5.8 (24-CH_3), 5.9 ($SiCH_2CH_3$), 7.2, 7.3, 7.4 (3×$SiCH_2CH_3$), 11.7, 11.8 (12-CH_3, 22-CH_3), 14.2 (2-CH_3), 16.1 (6-CH_3), 17.4 (4-CH_3), 18.4 (8-CH_3), 18.6 ($SiC(CH_3)_3$), 18.7 (C-6′), 25.0 (C-14), 26.3 ($SiC(CH_3)_3$), 34.8 (C-15), 37.1 (C-22), 38.2, 38.3 (C-8, C-18), 39.2 (C-26), 40.8 (C-24), 47.9 (21-OCH_3), 58.5 (17-OCH_3), 60.3 (28-OCH_3), 61.0 (4′-OCH_3), 67.9 (C-5′), 69.6 (C-25), 70.6 (C-23), 72.0 (C-19), 73.5 (C-27), 74.2 (C-16), 74.7, 74.8 (C-2′, C-3′), 75.9 (C-20), 78.1 (C-28), 82.3 (C-17), 82.6 (C-9), 87.9 (C-4′), 95.8 (C-1′), 102.1 (C-21), 124.2 (C-2), 125.6 (C-10), 132.1 (C-4), 132.4 (C-6), 133.2 (C-12), 133.5 (C-13), 140.5 (C-11), 141.2 (C-7), 144.8 (C-5), 145.9 (C-3), 169.7 (C-1); IR (film): $\tilde{\nu}$=3507 (brs), 2955 (s), 2877 (s), 1699 (s), 1602 (m), 1463 (s), 1415 (s), 1386 (s), 1246 (s), 1106 (s), 1017 (s), 981 (s), 838 (s), 740 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{69}H_{130}O_{15}Si_4Na$: 1333.8385; found 1333.8355 $[M+Na]^+$.

27-Hydroxy apoptolidin A (57): H_2SiF_6 (4×100 μL, aq 25–30%) was added at −40 °C to the protected macrolactone **61** (34 mg, 26 μmol) in CH_3CN (8 mL). After 1 d at −40 to −30 °C, the reaction mixture was stirred for 20 h at −25 to −15 °C. Phosphate buffer (10 mL, pH 7, 1 M) was added. The aqueous layer was extracted with $CHCl_3$/*i*PrOH (5×10 mL,

5:1). The combined organic layers were dried with Na_2SO_4. Chromatography (6 g neutral silica gel, CH_2Cl_2/MeOH 25:1 → 20:1) gave 27-hydroxy apoptolidin A (**57**) (17 mg, 20 μmol, 77%) as a white solid. The analytical data were identical with the data obtained from the deprotection starting with **55**.

Cyanomethyl-(2*E*,4*E*,6*E*,10*E*,12*E*,8*R*,9*R*,16*S*,17*S*,19*S*,20*R*,2′*R*,3′*R*,4′*S*,5′*R*,6′*R*,2″*R*)-20-[6′-{2″-*tert*-butyldimethylsiloxa-3″-methoxypropyl}-4′-triethylsilyloxy-2′-methoxy-3′,5′-dimethyl-2′,3′,5′,6′-tetrahydro-4*H*-pyran-2′-yl]-9-[6-deoxy-4-*O*-methyl-2,3-*O*-bis(triethylsilyl)-β-L-glucopyranosyl]-16,19,20-trihydroxy-17-methoxy-2,4,6,8,12-pentamethyl eicosapenta-2,4,6,10,12-enoate (62): According to the cross-coupling procedure (**43** + **52** → **53**), alkenyl stannane **59** (30 mg, 31 μmol) and alkenyl iodide **44** (30 mg, 37 μmol) were transformed with CuTC (18 mg, 93 μmol) into the cyanomethyl ester **62** (33 mg, 24 μmol, 78%). R_f=0.34 (*n*-hexane/MTBE 1:3); $[\alpha]_D^{19}$=+45.7 (*c*=1.25, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ= 0.152, 0.155 (2s, 6H, $SiCH_3$), 0.64 (q, *J*=7.9 Hz, 6H, $SiCH_2CH_3$), 0.80–0.97 (m, 12H, 2×$SiCH_2CH_3$), 1.01 (s, 9H, $SiC(CH_3)_3$), 1.02 (t, *J*=7.9 Hz, 9H, $SiCH_2CH_3$), 1.10–1.21 (m, 24H, 8-CH_3, 5′-CH_3, 2×$SiCH_2CH_3$), 1.24 (d, *J*=6.0 Hz, 3H, 6-H_3 gluco), 1.40 (d, *J*=6.6 Hz, 3H, 3′-CH_3), 1.50–1.61 (m, 3H, 15-H_2, 1″-H), 1.72–1.95 (m, 4H, 1″-H, 5′-H, 18-H_2), 1.76 (s, 3H, 6-CH_3), 1.82 (s, 3H, 12-CH_3), 1.88 (d, *J*=0.9 Hz, 3H, 4-CH_3), 1.91 (d, *J*= 1.4 Hz, 3H, 2-CH_3), 2.09–2.15 (br s, 1H, 16-OH), 2.27–2.36 (m, 1H, 14-H), 2.40–2.51 (m, 2H, 14-H, 3′-H), 2.69 (t, *J*=8,9 Hz, 1H, 4-H gluco), 2.68 (d, *J*=5.5 Hz, 1H, 20-OH), 3.03–3.10 (m, 2H, 8-H, 19-OH), 3.07 (s, 3H, OCH_3), 3.13 (dd, *J*=9.4, 4.6 Hz, 1H, 3″-H), 3.14–3.21 (m, 2H, 3″-H, 5-H gluco), 3.18, 3.27, 3.29 (3s, 9H, OCH_3), 3.34–3.39 (m, 1H, 17-H), 3.50–3.56 (m, 1H, 16-H), 3.58–3.68 (m, 3H, 20-H, (2, 3)-H gluco), 3.83 (s, 2H, OCH_2CN), 4.04–4.11 (m, 2H, 2″-H, 4′-H), 4.14–4.20 (m, 2H, 6′-H, 9-H), 4.23–4.29 (m, 1H, 19-H), 4.37 (d, *J*=7.3 Hz, 1H, 1-H gluco), 5.44 (d, *J*=9.9 Hz, 1H, 7-H), 5.57 (t, *J*=7.5 Hz, 1H, 13-H), 5.90 (dd, *J*=15.8, 8.5 Hz, 1H, 10-H), 5.97 (s, 1H, 5-H), 6.31 (d, *J*=15.6 Hz, 1H, 11-H), 7.25 (s, 1H, 3-H); ^{13}C NMR (125.8 MHz, C_6D_6): δ=−4.5, −3.6 ($SiCH_3$), 5.5 ($SiCH_2CH_3$), 5.7 (5′-CH_3), 5.78, 5.84 (2×$SiCH_2CH_3$), 7.2, 7.4, 7.5 ($SiCH_2CH_3$), 12.5 (3′-CH_3), 12.6 (12-CH_3), 14.1 (2-CH_3), 17.3 (6-CH_3), 17.8 (8-CH_3), 18.2 (4-CH_3), 18.5 ($SiC(CH_3)_3$), 19.0 (C-6 gluco), 25.2 (C-14), 26.2 ($SiC(CH_3)_3$), 33.4 (C-15), 36.7 (C-3′), 37.1 (C-18), 39.1 (C-8), 39.4 (C-1″), 40.7 (C-5′), 48.1 (OCH_2CN), 48.5 (2′-OCH_3), 58.5, 59.2, 60.4 (OCH_3), 67.7 (C-19), 69.4 (C-6′), 70.4 (C-4′), 71.2 (C-5 gluco), 72.9 (C-16), 73.9 (C-2″), 75.3 (C-20), 77.1 (C-2 gluco), 77.9 (C-3″), 78.6 (C-3 gluco), 82.2 (C-17), 86.1 (C-9), 87.0 (C-4 gluco), 101.5 (C-1 gluco), 103.1 (C-2′), 115.0 (OCH_2CN), 123.9 (C-2), 125.9 (C-10), 131.8, 132.4, 133.7 (C-4, C-6, C-12), 133.4 (C-13), 135.2 (C-7), 138.6 (C-11), 141.2 (C-5), 146.5 (C-3), 166.9 (C-1); IR (film): $\tilde{\nu}$=3465 (br s), 2987 (s), 2958 (s), 2876 (s), 2854 (s), 1721 (s), 1469 (s), 1458 (s), 1385 (s), 1360 (s), 1239 (s), 1108 (s), 1063 (s), 1006 (s), 998 cm^{-1} (s); HR-MS (ESI): *m*/*z*: calcd for $C_{71}H_{133}O_{16}Si_4Na$: 1390.8599; found 1390.8655 $[M+Na]^+$.

27-*O*-*tert*-Butyldimethylsilyl-9-*O*-[6-deoxy-4-*O*-methyl-2,3-*O*-bis(triethylsilyl)-L-β-glucopyranosyl]-21-*O*-methyl-23-*O*-triethylsilyl-apoptolidinone A (63): *Ester hydrolysis:* Cyanomethyl ester **62** (39 mg, 29 μmol) dissolved in THF/H_2O (4 mL, 3:1) was hydrolyzed with LiOH monohydrate (3.7 mg, 87 μmol) according to the procedure (**53** → **54**). The corresponding trihydroxy acid (31 mg, 24 μmol, 83%) was used without further purification for the following macrolactonization step. Analytical data of the acid: R_f=0.36 (CH_2Cl_2/MeOH 15:1); $[\alpha]_D^{19}$=+43.2 (*c*=1.00, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ=0.16 (s, 6H, $SiCH_3$), 0.64 (q, *J*=7.9 Hz, 6H, $SiCH_2CH_3$), 0.79–0.98 (m, 12H, 2×$SiCH_2CH_3$), 1.01 (s, 9H, $SiC(CH_3)_3$), 1.02 (t, *J*=7.9 Hz, 9H, $SiCH_2CH_3$), 1.10–1.22 (m, 24H, 8-CH_3, 5′-CH_3, 2×$SiCH_2CH_3$), 1.24 (d, *J*=6.1 Hz, 3H, 6-H_3 gluco), 1.41 (d, *J*= 6.5 Hz, 3H, 3′-CH_3), 1.50–1.63 (m, 3H, 15-H_2, 1″-H), 1.72–1.99 (m, 4H, 1″-H, 5′-H, 18-H_2), 1.75 (s, 3H, 6-CH_3), 1.82 (s, 3H, 12-CH_3), 1.91 (s, 3H, 4-CH_3), 2.07 (s, 3H, 2-CH_3), 2.25–2.37 (m, 1H, 14-H), 2.40–2.52 (m, 2H, 14-H, 3′-H), 2.65 (t, *J*=8,9 Hz, 1H, 4-H gluco), 3.01–3.12 (m, 1H, 8-H), 3.09 (s, 3H, OCH_3), 3.13–3.22 (m, 3H, 5-H gluco, 3″-H_2), 3.19, 3.29, 3.31 (3s, 9H, OCH_3), 3.35–3.43 (m, 1H, 17-H), 3.52–3.58 (m, 1H, 16-H), 3.58–3.70 (m, 3H, 20-H, (2, 3)-H gluco), 4.05–4.13 (m, 2H, 2″-H, 4′-H), 4.13–4.21 (m, 2H, 6′-H, 9-H), 4.25–4.32 (m, 1H, 19-H), 4.39 (d, *J*=7.2 Hz, 1H, 1-H gluco), 5.40 (d, *J*=9.9 Hz, 1H, 7-H), 5.57 (t, *J*=7.3 Hz, 1H, 13-H), 5.90 (dd, *J*=15.7, 8.5 Hz, 1H, 10-H), 6.01 (s, 1H, 5-H), 6.31 (d, *J*= 15.6 Hz, 1H, 11-H), 7.54 (s, 1H, 3-H); ^{13}C NMR (125.8 MHz, C_6D_6): δ= −4.5, −3.6 ($SiCH_3$), 5.5 ($SiCH_2CH_3$), 5.7 (5′-CH_3), 5.78, 5.83 (2×$SiCH_2CH_3$), 7.2, 7.4, 7.5 ($SiCH_2CH_3$), 12.5, 12.6 (3′-CH_3, 12-CH_3), 14.1 (2-CH_3), 17.3 (6-CH_3), 17.8 (8-CH_3), 18.3 (4-CH_3), 18.5 ($SiC(CH_3)_3$), 19.0 (C-6 gluco), 25.2 (C-14), 26.2 ($SiC(CH_3)_3$), 33.4 (C-15), 36.7, 37.1 (C-3′, C-18), 39.2, 39.4 (C-8, C-1″), 40.7 (C-5′), 48.5 (2′-OCH_3), 58.5, 59.2, 60.4 (3×OCH_3), 67.8 (C-19), 69.4 (C-6′), 70.4 (C-4′), 71.2 (C-5 gluco), 72.9 (C-16), 74.0 (C-2″), 75.3 (C-20), 77.1 (C-2 gluco), 77.9 (C-3″), 78.6 (C-3 gluco), 82.2 (C-17), 86.1 (C-9), 87.0 (C-4 gluco), 101.5 (C-1 gluco), 103.1 (C-2′), 125.3 (C-2), 126.0 (C-10), 132.2, 132.5, 133.2 (C-4, C-6, C-12), 133.7 (C-13), 134.7 (C-7), 138.5 (C-11), 140.6 (C-5), 146.2 (C-3), 174.0 (C-1); IR (film): $\tilde{\nu}$=3447 (br s), 2989 (s), 2958 (s), 1681 (s), 1469 (s), 1458 (s), 1415 (s), 1360 (s), 1278 (s), 1238 (s), 1060 (s), 1006 (s), 967 cm^{-1} (s); HR-MS (ESI): *m*/*z*: calcd for $C_{69}H_{132}O_{16}Si_4Na$: 1351.8490; found 1351.8509 $[M+Na]^+$.

Macrolactonization: Trihydroxy acid (31 mg, 23 μmol), Et_3N (140 μL, 0.98 mmol), 2,4,6-trichlorobenzoyl chloride (75 μL, 0.47 mmol) in THF (3 mL) was added to DMAP (236 mg, 1.94 mmol) in toluene (35 mL) as described for the macrolactonization (**54** → **55**). After chromatography (5 g silica gel, cyclohexane/AcOEt 8:1 → 5:1) macrolactone **63** (15 mg, 11 μmol, 48%) was obtained as a colorless oil. R_f=0.31 (*n*-hexane/MTBE 3:2); $[\alpha]_D^{19}$=+16.0(*c*=0.55, $CHCl_3$); ^{1}H NMR (500 MHz, C_6D_6): δ=0.17, 0.18 (2s, 6H, $SiCH_3$), 0.62 (q, *J*=8.0 Hz, 6H, $SiCH_2CH_3$), 0.83–1.04 (m, 30H, 2×$SiCH_2CH_3$, $SiC(CH_3)_3$, $SiCH_2CH_3$), 1.15 (t, *J*=8.0 Hz, 9H, $SiCH_2CH_3$), 1.19 (t, *J*=7.8 Hz, 9H, $SiCH_2CH_3$), 1.24 (d, *J*=6.1 Hz, 3H, 6′-CH_3), 1.29 (d, *J*=7.0 Hz, 24-CH_3), 1.33 (d, *J*=6.7 Hz, 3H, 8-H_3), 1.37–1.46 (m, 1H, 15-H), 1.46–1.52 (m, 1H, 15-H), 1.54 (d, *J*=6.6 Hz, 3H, 22-CH_3), 1.60 (s, 3H, 12-CH_3), 1.66 (ddd, *J*=14.2, 7.9, 3.2 Hz, 1H, 26-H), 1.72 (s, 3H, 6-CH_3), 1.83 (s, 6H, 4-CH_3), 1.88–1.98 (m, 2, 24-H, 26-H), 1.99–2.09 (m, 1H, 14-H), 2.13 (s, 3H, 2-CH_3), 2.18–2.33 (m, 4H, 18-H_2, 22-H, 16-OH), 2.41 (br s, 1H, 20-OH), 2.53–2.62 (m, 1H, 14-H), 2.68 (t, *J*=9.0 Hz, 1H, 4′-H), 2.85–2.94 (m, 1H, 8-H), 3.01–3.08 (m, 1H, 17-H), 3.07 (s, 3H, OCH_3), 3.16–3.23 (m, 3H, 5′-H, 28-H_2), 3.19 (OCH_3), 3.29, 3.38 (2×OCH_3), 3.47–3.54 (m, 1H, 16-H), 3.65 (t, *J*=8.5 Hz, 1H, 3′-H), 3.71 (dd, *J*=8.2, 7.7 Hz, 1H, 2′-H), 3.90 (br d, *J*=4.9 Hz, 1H, 20-H), 3.95 (t, *J*=9.3 Hz, 1H, 9-H), 4.11–4.18 (m, 1H, 27-H), 4.16 (dd, *J*=10.3, 4.7 Hz, 1H, 23-H), 4.21 (dt, *J*=8.1, 2.7 Hz, 1H, 25-H), 4.45 (d, *J*=7.4 Hz, 1H, 1′-H), 5.02 (d, *J*=10.1 Hz, 1H, 7-H), 5.55–5.60 (m, 2H, 10-H, 13-H), 5.95 (ddd, *J*=10.3, 5.6, 3.1 Hz, 1H, 19-H), 6.02 (d, *J*=15.7 Hz, 1H, 11-H), 6.20 (s, 1H, 5-H), 7.56 (s, 1H, 3-H); ^{13}C NMR (125.8 MHz, C_6D_6): δ=−4.5, −3.5 ($SiCH_3$), 5.5, 5.80 (2×$SiCH_2CH_3$), 5.85 (24-CH_3, $SiCH_2CH_3$), 7.2, 7.4 (2C) (3×$SiCH_2CH_3$), 11.7, 11.9 (12-CH_3, 22-CH_3), 14.2 (2-CH_3), 16.2 (6-CH_3), 17.4 (4-CH_3), 18.4 (8-CH_3), 18.6 ($SiC(CH_3)_3$), 19.0 (C-6′), 25.1 (C-14), 26.3 ($SiC(CH_3)_3$), 34.8 (C-15), 37.1 (C-22), 38.3 (C-18), 39.2 (C-26), 39.6 (C-8), 40.8 (C-24), 47.9 (21-OCH_3), 58.5, 60.37, 60.41 (3×OCH_3), 69.6 (C-25), 70.6 (C-5′), 71.1 (C-23), 72.0 (C-19), 73.5 (C-27), 74.3 (C-16), 75.9 (C-20), 77.2 (C-2′), 78.1 (C-28), 78.7 (C-3′), 82.3 (C-17), 87.0 (C-4′), 87.8 (C-9), 101.8 (C-1′), 102.1 (C-21), 124.2 (C-2), 126.7 (C-10), 131.8, 132.1 (C-4, C-6), 132.7 (C-13), 133.8 (C-12), 138.4 (C-11), 141.4 (C-7), 144.8 (C-5), 145.8 (C-3), 169.7 (C-1); IR (film): $\tilde{\nu}$=3501 (br s), 2954 (s), 2928 (s), 2874 (s), 2854 (s), 1699 (s), 1602 (s), 1463 (s), 1418 (s), 1386 (s), 1247 (s), 1087 (s), 1017 (s), 975 (s), 937 (s), 834 (s), 740 cm^{-1} (s); HR-MS (ESI): *m*/*z*: calcd for $C_{69}H_{130}O_{15}Si_4Na$: 1333.8385; found 1333.8326 $[M+Na]^+$.

9-*O*-(6-Deoxy-4-*O*-methyl-L-β-glucopyranosyl)-apoptolidinone A (64): H_2SiF_6 (120 μL, aq 25–30%) was added at −40 °C to protected macrolactone **63** (13 mg, 10 μmol) in CH_3CN (3 mL). After 1 d at −40 to −30 °C, the reaction mixture was stirred for 20 h at −25 to −15 °C. Phosphate buffer (10 mL, pH 7, 1 M) was added. The aqueous layer was extracted with $CHCl_3$/*i*PrOH (5×10 mL, 5:1). The combined org. layers were dried with Na_2SO_4. Chromatography (6 g neutral silica gel, CH_2Cl_2/MeOH 25:1→20:1) gave compound **64** (7.5 mg, 8.9 μmol, 89%) as an amorphous solid. R_f=0.21 ($CHCl_3$/MeOH 8:1); HPLC: t_R=5.3 min (Dynamax C18, A: H_2O, B: MeOH, 70→100% B in 25 min, 0.7 mL min^{-1}, 30 °C); $[\alpha]_D^{21}$= +79 (*c*=0.60, $CHCl_3$); ^{1}H NMR (500 MHz, CD_3OD): δ=0.91 (d, *J*= 6.9 Hz, 3H, 24-CH_3), 1.05 (d, *J*=6.6 Hz, 3H, 22-CH_3), 1.21 (d, *J*= 6.46 Hz, 3H, 8-CH_3), 1.24 (d, *J*=6.2 Hz, 6′-H_3), 1.29–1.36 (m, 1H, 26-H), 1.40–1.48 (m, 1H, 15-H), 1.51–1.60 (m, 1H, 15-H), 1.61 (ddd, *J*=14.1, 9.1, 2.5 Hz, 1H, 26-H), 1.70 (s, 3H, 12-CH_3), 1.72–1.83 (m, 2H, 18-H, 24-H), 1.95 (s, 3H, 6-CH_3), 2.03–2.24 (m, 3H, 14-H, 18-H, 22-H), 2.14 (s,

3H, 2-CH_3), 2.21 (s, 3H, 4-CH_3), 2.45–2.54 (m, 1H, 14-H), 2.64–2.79 (m, 2H, 8-H, 17-H), 2.74 (t, J=9.3 Hz, 1H, 4′-H), 3.17–3.29 (m, 4H, 28-H_2, 2′-H, 5′-H), 3.32 (s, 3H, 28-OCH_3), 3.39 (s, 3H, 17-OCH_3), 3.38–3.43 (1H, 3′-H, under 17-OCH_3), 3.44–3.50 (m, 1H, 16-H), 3.54–3.62 (m, 2H, 20-H, 27-H, under 4′-OCH_3), 3.58 (s, 3H, 4′-OCH_3), 3.78 (dd, J=11.1, 4.7 Hz, 1H, 23-H), 3.86 (t, J=9.2 Hz, 1H, 9-H), 4.12 (ddd, J=8.4, 2.3, 2.1 Hz, 1H, 25-H), 4.29 (d, J=8.0 Hz, 1H, 1′-H), 5.23 (d, J=10.3 Hz, 1H, 7-H), 5.33 (d, J=11.2 Hz, 1H, 19-H), 5.40 (dd, J=15.8, 9.2 Hz, 1H, 10-H), 5.68 (dd, J=8.7, 6.9 Hz, 1H, 13-H), 6.11 (d, J=15.8 Hz, 1H, 11-H), 6.21 (s, 1H, 5-H), 7.39 (s, 1H, 3-H); ^{13}C NMR (125.8 MHz, CD_3OD): δ= 5.2 (24-CH_3), 12.1, 12.2 (12-CH_3, 22-CH_3), 14.0 (2-CH_3), 16.4 (6-CH_3), 17.8 (4-CH_3), 18.0 (8-CH_3), 18.4 (C-6′), 24.6 (C-14), 36.4, 36.5 (C-15, C-22), 38.4, 38.5 (C-18, C-26), 39.8 (C-8), 40.8 (C-24), 59.4 (28-OCH_3), 60.9 (4′-OCH_3), 61.3 (17-OCH_3), 68.1 (C-27), 69.2 (C-25), 72.2, 72.3 (C-19, C-5′), 73.8 (C-23), 74.6 (C-16), 75.5 (C-20), 75.9 (C-2′), 78.1 (C-3′), 78.6 (C-28), 83.8 (C-17), 87.0 (C-4′), 90.3 (C-9), 101.3 (C-21), 104.0 (C-1′), 123.9 (C-2), 128.8 (C-10), 132.5 (C-13), 132.1, 133.2, 134.9 (C-4, C-6, C-12), 137.9 (C-11), 142.9 (C-7), 147.1 (C-5), 149.0 (C-3), 172.6 (C-1); IR (film): $\tilde{\nu}$=3414 (brs), 2977 (s), 2931 (s), 1666 (s), 1597 (s), 1455 (s), 1388 (s), 1258 (s), 1167 (s), 1103 (s), 1072 (s), 1018 (s), 967 (s), 896 (s), 667 cm^{-1} (s); HR-MS (ESI): m/z: calcd for $C_{44}H_{72}O_{15}Na$: 863.4769; found 863.4743 $[M+Na]^+$.

Acknowledgements

This work was supported by Schering AG Berlin (Dr. D. Mumberg) and the Fonds der Chemischen Industrie. H.W. thanks the Schering Forschungsgesellschaft for a predoctoral fellowship. The authors thank Prof. Dr. U. Eder for his helpful support.

[1] T. K. Lindhorst in *Glycoscience III* (Eds.: B. F. Ried, K. Tatsuta, J. Thiem), Springer, Berlin, **2001**, Chapter 9.1, pp. 2393–2439.
[2] V. Kren, L. Martinkova, *Curr. Med. Chem.* **2001**, *8*, 1303–1328.
[3] P. T. Daniel, U. Koert, J. Schuppan, *Angew. Chem.* **2006**, *118*, 886–908; *Angew. Chem. Int. Ed.* **2006**, *45*, 872–893.
[4] a) J. W. Kim, H. Adachi, K. Shin-ya, Y. Hayakawa, H. Seto, *J. Antibiot.* **1997**, *50*, 628–630; b) Y. Hayakawa, J. W. Kim, H. Adachi, K. Shin-ya, K. Fujita, H. Seto, *J. Am. Chem. Soc.* **1998**, *120*, 3524–3525.
[5] P. A. Wender, M. Sukopp, K. Longcore, *Org. Lett.* **2005**, *7*, 3025–3028.
[6] a) A. R. Salomon, D. W. Voehringer, L. A. Herzenberg, C. Khosla, *Proc. Natl. Acad. Sci. USA* **2000**, *97*, 14766–14771; b) A. R. Salomon, D. W. Voehringer, L. A. Herzenberg, C. Khosla, *Chem. Biol.* **2001**, *8*, 71–80; c) A. R. Salomon, Y. Zhang, H. Seto, C. Khosla, *Org. Lett.* **2001**, *3*, 57–59; d) P. A. Wender, A. V. Gulledge, O. D. Jankowski, H. Seto, *Org. Lett.* **2002**, *4*, 3819–3822; e) P. A. Wender, O. D. Jankowski, E. A. Tabet, H. Seto, *Org. Lett.* **2003**, *5*, 487–490.
[7] J. Schuppan, H. Wehlan, S. Keiper, U. Koert, *Angew. Chem.* **2001**, *113*, 2125–2128; *Angew. Chem. Int. Ed.* **2001**, *40*, 2063–2066.
[8] J. Schuppan, H. Wehlan, S. Keiper, U. Koert, *Chem. Eur. J.* **2006**, *12*, 7364–7377.
[9] H. Wehlan, M. Dauber, M. T. Mujica Fernaud, J. Schuppan, M. E. Juarez Garcia, R. Mahrwald, U. Koert, *Angew. Chem.* **2004**, *116*, 4698–4702; *Angew. Chem. Int. Ed.* **2004**, *43*, 4597–4601.
[10] a) K. C. Nicolaou, Y. Li, K. C. Fylaktakidou, H. J. Mitchell, H. X. Wei, B. Weyershausen, *Angew. Chem.* **2001**, *113*, 3968–3972; *Angew. Chem. Int. Ed.* **2001**, *40*, 3849–3854; b) K. C. Nicolaou, Y. Li, K. C. Fylaktakidou, H. J. Mitchell, K. Sugita, *Angew. Chem.* **2001**, *113*, 3972–3976; *Angew. Chem. Int. Ed.* **2001**, *40*, 3854–3857; c) K. C. Nicolaou, K. C. Fylaktakidou, H. Monenschein, Y. Li, B. Weyershausen, H. J. Mitchell, H. X. Wei, P. Guntupalli, D. Hepworth, K. Sugita, *J. Am. Chem. Soc.* **2003**, *125*, 15433–15442; d) K. C. Nicolaou, Y. Li, K. Sugita, H. Monenschein, P. Guntupalli, H. J. Mitchell, K. C. Fylaktakidou, D. Vourloumis, P. Giannakakou, A. O'Brate, *J. Am. Chem. Soc.* **2003**, *125*, 15443–15454.
[11] B. Wu, Q. Liu, G. A. Sulikowski, *Angew. Chem.* **2004**, *116*, 6841–6843; *Angew. Chem. Int. Ed.* **2004**, *43*, 6673–6675.
[12] M. T. Crimmins, H. S. Christie, K. Chaudhary, A. Long, *J. Am. Chem. Soc.* **2005**, *127*, 13810–13812.
[13] a) J. Schuppan, B. Ziemer, U. Koert, *Tetrahedron Lett.* **2000**, *41*, 621–624; b) K. C. Nicolaou, Y. Li, B. Weyershausen, H.-X. Wei, *Chem. Commun.* **2000**, 307–308; c) G. A. Sulikowski, W.-M. Lee, B. Jin, B. Wu, *Org. Lett.* **2000**, *2*, 1439–1442; d) K. Toshima, T. Arita, K. Kato, D. Tanaka, S. Matsumura, *Tetrahedron Lett.* **2001**, *42*, 8873–8876; e) Y. Chen, J. B. Evarts, E. Torres, P. L. Fuchs, *Org. Lett.* **2002**, *4*, 3571–3574; f) J. D. Pennington, H. J. Williams, A. R. Salomon, G. A. Sulikowski, *Org. Lett.* **2002**, *4*, 3823–3825; g) K. Abe, K. Kato, T. Arai, M. A. Rahim, I. Sultana, S. Matsumura, K. Toshima, *Tetrahedron Lett.* **2004**, *45*, 8849–8853; h) W. D. Paquette, R. E. Taylor, *Org. Lett.* **2004**, *6*, 103–106; i) M. T. Crimmins, A. Long, *Org. Lett.* **2005**, *7*, 4157–4160; j) B. Jin, Q. Liu, G. A. Sulikowski, *Tetrahedron* **2005**, *61*, 401–408.
[14] a) R. W. Binkley, G. S. Goewey, J. C. Johnston, *J. Org. Chem.* **1984**, *49*, 992–996; b) A. Liptak, P. Nanasi, *Tetrahedron* **1980**, *36*, 1261–1268.
[15] G. Jung, A. Klemer, *Chem. Ber.* **1981**, *114*, 740–745.
[16] D. P. Sebesta, W. R. Roush, *J. Org. Chem.* **1992**, *57*, 4799–4802.
[17] R. Preuss, R. R. Schmidt, *Synthesis* **1988**, 694–697.
[18] I. Bajza, A. Liptak, *Carbohydr. Res.* **1990**, *205*, 435–439.
[19] A related route to the 6-deoxy-L-glucose building block was chosen by Nicolaou (ref. [10a,c]).
[20] A. V. Demchenko, *Synlett* **2003**, 1225–1240.
[21] D. Kahne, S. Walker, Y. Cheng, D. VanEngen, *J. Am. Chem. Soc.* **1989**, *111*, 6881–6882.
[22] K. C. Nicolaou, S. P. Seitz, D. P. Papahatjis, *J. Am. Chem. Soc.* **1983**, *105*, 2430–2434.
[23] a) S. A. Robertson, J. A. Ellman, P. G. Schultz, *J. Am. Chem. Soc.* **1991**, *113*, 2722–2729; b) R. Shen, C. Ting Lin, J. A. Porco Jr., *J. Am. Chem. Soc.* **2002**, *124*, 5650–5651.
[24] a) J. Thiem, K. J. Schwentner, *Synthesis* **1978**, 696–698; b) J. Thiem, M. Gerken, *J. Org. Chem.* **1985**, *50*, 954–958.
[25] M. T. Reetz, *Angew. Chem.* **1984**, *96*, 542–555; *Angew. Chem. Int. Ed. Engl.* **1984**, *23*, 556–569.
[26] G. D. Allred, L. S. Liebeskind, *J. Am. Chem. Soc.* **1996**, *118*, 2748–2749.
[27] M. Hikota, H. Tone, K. Horita, O. Yonemitsu, *J. Org. Chem.* **1990**, *55*, 7–9.
[28] A. S. Pilcher, D. K. Hill, S. J. Shimshock, R. E. Waltermire, P. DeShong, *J. Org. Chem.* **1992**, *57*, 2492–2495.
[29] Chromatotrex silicagel MB 100-40/75 from Fuji Silysia Chemical LTD.

Received: April 3, 2006
Published online: July 25, 2006

