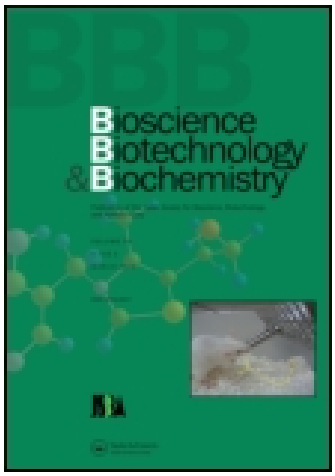

Bioscience, Biotechnology, and Biochemistry
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/tbbb20

Facile Synthesis of Methyl 2-O-α-L-rhamnopyranosyl-α-L-rhamnopyranoside and Methyl 2-O-α-L-mannopyranosyl-α-L-rhamnopyranoside

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Published online: 12 Jun 2014.

To cite this article: Sachiko Esaki, Akiko Katsumata, Naoko Sugiyama & Shintaro Kamiya (1992) Facile Synthesis of Methyl 2-O-α-L-rhamnopyranosyl-α-L-rhamnopyranoside and Methyl 2-O-α-L-mannopyranosyl-α-L-rhamnopyranoside, Bioscience, Biotechnology, and Biochemistry, 56:9, 1480-1481, DOI: 10.1271/bbb.56.1480

To link to this article: http://dx.doi.org/10.1271/bbb.56.1480

Biosci. Biotech. Biochem., **56** (9), 1480—1481, 1992

Note

Facile Synthesis of Methyl 2-*O*-α-L-rhamnopyranosyl-α-L-rhamnopyranoside and Methyl 2-*O*-α-L-mannopyranosyl-α-L-rhamnopyranoside

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Received February 24, 1992

2-*O*-α-L-Rhamnopyranosyl-L-rhamnopyranose (**1**) is a natural product occurring as the constituent of bacterial cell-wall polysaccharides.[1] Several synthetic methods for producing **1** have been reported using methyl α-L-rhamnopyranoside,[2] benzyl 4-*O*-benzyl-α-L-rhamnopyranoside,[3] methyl 3,4-di-*O*-benzyl-α-L-rhamnopyranoside,[4] methyl 4-*O*-acetyl-α-L-rhamnopyranoside,[5] benzyl 3,4-di-*O*-benzyl-α-L-rhamnopyranoside,[6] meththyl 3,4-di-*O*-benzoyl-α-L-rhamnopyranoside,[7] or methyl 3,4-di-*O*-acetyl-1,2-*O*-(1-*p*-tolyl-thioethylidene)-α-L-rhamnopyranoside[8] as the glycosyl acceptor in the condensation reaction. However, purification of the disaccharide derivatives obtained from the reactions using these foregoing glycosyl acceptors usually required column chromatographic separation.

Methyl 2-*O*-α-L-mannopyranosyl-α-L-rhamnopyranoside (**2**), which is structurally related to the common polysaccharide antigen group *B. streptococci*,[9] has been synthesized as a syrup by coupling[9] methyl 3,4-di-*O*-benzyl-1-thio-α-L-mannopyranoside with tetra-*O*-acetyl-α-L-mannopyranosyl bromide (**3**), or by reacting[7] methyl 3,4-di-*O*-benzoyl-α-L-rhamnopyranoside and tetra-*O*-benzoyl-α-L-mannopyranosyl bromide, with subsequent deprotection.

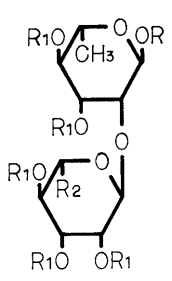
We needed a large amount of the methyl glycoside (**4**) of **1** as an intermediate for preparing sweet-tasting dihydrochalocone glycosides,[10] and also a substantial amount of **2** as a substrate for fungal α-L-mannosidase.[11]

We report here a simple, rapid and high-yielding method for the preparation of **2** and **4**.

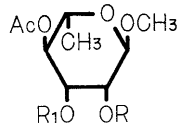
Easily obtainable methyl 4-*O*-acetyl-α-L-rhamnopyranoside[5] was treated at −5—0°C with 1.1 molar equivalent of acetyl chloride to give a mixture, from which methyl 3,4-di-*O*-acetyl-α-L-rhamnopyranoside (**5**) was isolated in crystalline form in a 42.8% yield by fractional crystallization. Column chromatograhy of the mother liquor afforded the 2,4-diacetate (**6**) in a 6.5% yield.

Condensation of **5** with tri-*O*-acetyl-α-rhamnopyranosyl bromide (**7**) in acetonitrile in the presence of $Hg(CN)_2$ and $HgBr_2$ gave crystalline methyl 3,4-di-*O*-acetyl-2-*O*-(2,3,4-tri-*O*-acetyl-α-L-rhamnopyranosyl)-α-L-rhamnopyranoside (**8**) in an 83% yield without resort to column chromatography. Deacetylation of **8** gave **4** in a quantitative yield.

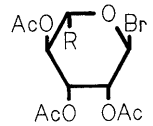
Condensation of **5** with **3** as described for the reaction of **5** with **7** gave a mixture from which methyl 3,4-di-*O*-acetyl-2-*O*-(2,3,4-tri-*O*-acetyl-α-L-mannopyranosyl)-α-L-rhamnopyranoside (**9**) was isolated in a 35% yield by fractional crystallization. Column chromatography of the mother liquor gave another **9** in a 30% yield. Deacetylation of **9** with methanolic sodium methoxide yielded crystalline compound **2**.



1 R=H , R1=H , R2=CH3
2 R=CH3, R1=H , R2=CH2OH
4 R=CH3, R1=H , R2=CH3
8 R=CH3, R1=Ac, R2=CH3
9 R=CH3, R1=Ac, R2=CH2OAc



5 R=H , R1=Ac
6 R=Ac, R1=H



3 R=CH2OAc
7 R=CH3

Experimental

Methyl 3,4-di-O-acetyl-α-L-rhamnopyranoside (**5**). To a solution of methyl 4-*O*-acetyl-α-L-rhamnopyranoside (60.6 g) in dichloromethane (280 ml) and pyridine (120 ml) was added dropwise at −5—0 °C a solution of acetyl chloride (22 ml) in dichloromethane (80 ml). The solution was stirred for one hour at the same temperature. After diluting with chloroform, the mixture was successively washed with 5% HCl, sat. $NaHCO_3$, and water, dried over $CaCl_2$ and concentrated. The residue was crystallized from ether–hexane (1 : 1) to give **5** as needles (34.8 g, 48.2%). R_f 0.34 (toluene–ethyl acetate, 2 : 1), mp 128—129°C, $[\alpha]_D^{20}$ −100° ($c=1$, $CHCl_3$). NMR δ_H ($CDCl_3$): 1.16 (3H, d, $J=6$ Hz, CH_3); 1.97, 2.03 (each 3H, s, 2 Ac); 3.33 (3H, s, OCH_3); 3.60—4.03 (2H, m, H-2,5): 4.63 (1H, d, $J=1.5$ Hz, H-1); 5.05 (1H, t, $J=9$ Hz, H-3); 5.1 (1H, d, $J=1$ Hz, H-4). *Anal.* Found: C, 50.21; H, 7.01%. Calcd. for $C_{11}H_{18}O_7$: C, 50.38; H, 6.87%.

The mother liquor was concentrated, and the residue was chromatographed on a column of silica gel (toluene–ethyl aectate, 9 : 1) to yield methyl 2,4-di-*O*-acetyl-α-L-rhamnopyranoside (4.7 g, 6.5%), mp 100°C, $[\alpha]_D^{20}$ −36° ($c=1$, $CHCl_3$), R_f 0.56 (toluene–ethyl acetate, 2 : 1). Lit.[4] mp 100°C, $[\alpha]_D^{20}$ −31.6°.

Methyl 3,4-di-O-acetyl-2-O-(2,3,4-tri-O-acetyl-α-L-rhamnopyranosyl)-α-L-rhamnopyranoside (**8**). To a solution of **5** (5.24 g) in acetonitrile (100 ml) containing Hg $(CN)_2$ (2.52 g) and $HgBr_2$ (3.58 g) was added **7** (7 g). The mixture was kept overnight at room temperature and processed.[12] Crystallization of the redulting syrup from ethanol afforded **8** (8.5 g, 83.3%), mp 153°C (ethanol), $[\alpha]_D^{20}$ −49° ($c=1$, $CHCl_3$), R_f 0.26 (benzene–ethyl acetate, 4 : 1). Lit.,[4] mp 151—153°C, $[\alpha]_D^{20}$ −44.8°. NMR δ_H ($CDCl_3$): 1.13, 1.22 (each 3H, d, $J=6$ Hz, $2CH_3$); 1.94, 1.96, 2.0, 2.02, 2.08 (each s, 3H, 5 Ac); 3.32 (3H, s, OCH_3); 3.60—4.10 (3H), 4.60 (1H), 4.76 (1H), 4.86—5.40 (5H), (ring protons). The ^{13}C-NMR spectrum of **8** was identical with that reported.[4]

Methyl 2-O-(α-L-rhamnopyranosyl)-α-L-rhamnopyranoside (**4**). Deacetylation of **8** with 0.1 N methanolic sodium methoxide in the usual manner gave **4** as a colorless syrup. $[\alpha]_D^{20}$ −90° ($c=1$, H_2O). Lit.[4] −92°.

Methyl 3,4-di-O-acetyl-2-O-(2,3,4,6-tetra-O-acetyl-α-L-mannopyranosyl)-α-L-rhamnopyranoside (**9**). To a solution of **5** (8.16 g) in acetonitrile (155 ml) containing $Hg(CN)_2$ (3.92 g) and $HgBr_2$ (5.57 g) was added **3** (12.8 g). The mixture was kept overnight at room temperature and processed.[12] Crystallization of the resulting syrup from ethanol gave **9** (6.45 g, 35.0%). The mother liquor was concentrated, and the residue was chromatographed in a column of silica gel (benzene–ethyl acetate, 10 : 1) to afford more **9** (5.52 g, 30%) as neddles, mp 158—160 °C, $[\alpha]_D^{20}$ −53° ($c=1$, $CHCl_3$). R_f 0.39 (benzene–ethyl acetate, 2 : 1). NMR δ_H ($CDCl_3$): 1.22 (3H, d, $J=6$ Hz, CH_3); 1.98, 2.00, 2.03, 2.10 (each s, total 18H, 6 Ac); 3.36 (3H, s, OCH_3); 3.60—4.30 (6H, m); 4.70 (1H, s); 4.86 (1H, s), 4.96—5.55 (5H, m), (ring protons). δ_C ($CDCl_3$): 17.48 (C_5–CH_3); 20.64, 20.79 (6 CH_3CO); 54.89 (OCH_3); 62.59 (C′-6); 66.22 (C′-4); 66.45 (C-5); 68.53 (C′-2), 69.11 (C-3); 69.72 (C′-3); 70.45 (C-4); 71.27 (C′-5); 77.00 (C-2); 99.21 (C-1, C′-1); 169.39, 169.49, 169.64, 169.67, 170.26, 170.31 (6 CO). *Anal.* Found: C, 50.71, H. 6.06%. Calcd. for $C_{25}H_{36}O_{16}$; C, 50.67; H, 6.08%.

Methyl 2-O-(α-L-mannopyranosyl)-α-L-rhamnopyranoside (**2**). Deacetylation of **9** (0.3 g) with 0.1 N methanolic sodium methoxide (25 ml) gave, in a quantitative yield, **2** as a syrup, which crystallized on standing in a refrigerator, mp 103—105°C, $[\alpha]_D^{20}$ −52° (H_2O). Lit.[7] −49°. Both ^{1}H- and ^{13}C-NMR spectra were identical with those reported.[7]

References

1) L. Kenne, B. Lindberg, K. Peterson, E. Katzenellenbogen, and E. Romanowska, *Eur. J. Biochem.*, **91**, 279—284 (1978).
2) C. Laffite, A. M. N. P. Du, F. Winternitz, R. Wylde, and F. Pratviel-Sosa, *Carbohydr. Res.*, **67**, 91—103 (1978).
3) W. Schalch, W. Hochstrasser, and D. G. Braun, *Tetrahedron Lett.*, 4153—4154 (1978).
4) A. Lipták, P. Nánási, A. Neszmélyi, and H. Wagner, *Tetrahedron*, **36**, 1261—1268 (1980).
5) D. Schwarzenbach and R. W. Jeanloz, *Carbohydr. Res.*, **81**, 323—329 (1980).
6) V. Pozsgay, P. Nánási, and A. Neszmélyi, *Carbohydr. Res.*, **90**, 215—231 (1981).
7) N. E. Byramova, L. V. Backinowsky, and N. K. Kochetkov, *Bull. Acad. Sci. USSR Chem. Sec.*, **5**, 1024—1230 (1985). T. Norberg, S. Oscarson, and M. Szonyi, *Carbohydr. Res.*, **156**, 214—217 (1986).
8) L. V. Backinowsky, Y. E. Tsvetkov, N. F. Balan, N. E. Byramora, and N. K. Kochetkov, *Carbohydr. Res.*, **85**, 209—221 (1980).
9) V. Pozsgay and H. J. Jennings, *J. Org. Chem.*, **53**, 4042—4052 (1988).
10) R. M. Horowitz and B. Gentili, *J. Agric. Food Chem.*, **17**, 696—700 (1969).
11) M. Michon, V. Pozsgay, J-R. Brisson, and H. J. Jennings, *Carbohydr. Res.*, **194**, 321—324 (1989).
12) B. Helferich and J. Zirner, *Chem. Ber.*, **95**, 2604—2611 (1962).