Crystal structure of 8,9-O-isopropylidine-Neu5Ac-methylester-methyl-ketoside, $C_{16}H_{27}NO_9$

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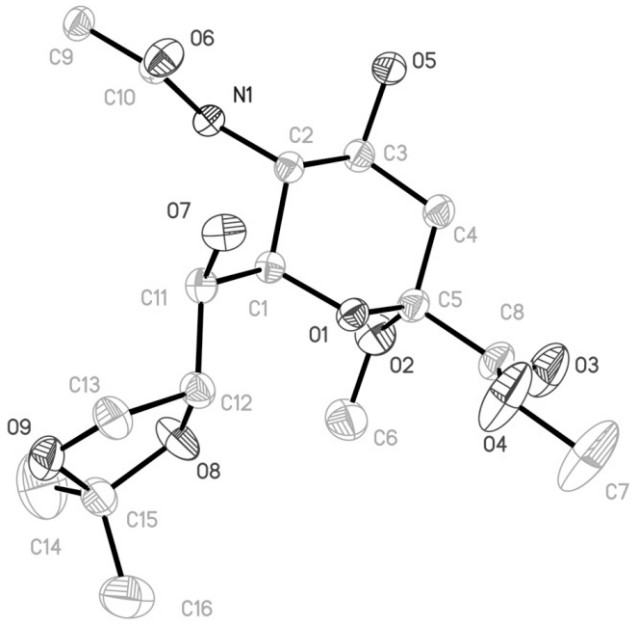

Abstract

$C_{16}H_{27}NO_9$, monoclinic, *C*2 (no. 5), a = 22.868(3) Å, b = 6.1707(7) Å, c = 17.334(2) Å, β = 126.834(1)°, V = 1957.7 Å^3, Z = 4, $R_{gt(F)}$ = 0.0554, $wR_{ref(F^2)}$ = 0.1611, T = 293 K.

Table 1. Data collection and handling.

Crystal:	colourless blocks, size 0.10×0.15×0.18 mm
Wavelength:	Mo K_α radiation (0.71073 Å)
μ:	1.05 cm^{-1}
Diffractometer, scan mode:	Bruker APEX II CCD, φ and ω
$2\theta_{max}$:	50°
$N(hkl)_{measured}$, $N(hkl)_{unique}$:	4875, 3033
Criterion for I_{obs}, $N(hkl)_{gt}$:	$I_{obs} > 2\ \sigma(I_{obs})$, 2863
$N(param)_{refined}$:	245
Programs:	SHELXS-97 [7]

Source of material

Starting materials and solvents for synthesis were purchased commercially, except for *N*-acetylneuraminic acid (Neu5Ac) methyl ester methyl ketoside, which was prepared according to reference [6]. A mixture of Neu5Ac methyl ester methyl ketoside (6.0 g) and *p*-toluene- sulfonic acid (0.15 g, pH = 1.0) in dry anhydrous acetone (100 mL) was stirred at room temperature for 3 hours, then neutralized with TEA to pH = 6-7. The solution was evaporated to dryness. The solid was triturated and washed with ether, then purified by chromatography (CH_2Cl_2 : CH_3OH : TEA = 95 : 5 : 0.1) to afford the product in the yield of 62.5% as a white powder. Colourless crystals were obtained by slow evaperation from the methanol solution containing the product.

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Experimental details

All H atoms on C atoms were generated geometrically and refined as riding atoms with d(C–H) = 0.96-0.98 Å, and U_{iso}(H) = 1.2 U_{eq} (C) for C atoms of CH_2 and CH groups and U_{iso}(H) = 1.5 U_{eq}(C) for C atoms of CH_3 groups. This is also true for the hydrogen atom of hydroxyl groups. The hydrogen atom of N1 atom has been added on the basis of the Q peak, the bond H–N has been constrained with 'dfix' command in a distance of 0.82 Å, with deviation 0.01. In addition, the 'PART' command has been used to deal the disorder of O9 atom.

Discussion

Sialic acids, as the most familiar terminal monosaccharides of glycoconjugates, are attached to glycoproteins and glycolipids in the membrane of living cells. One of the most interesting properties of sialic acid is its structural diversity, and over 40 kinds of derivatives of N-acetylneuraminic acid (Neu5Ac) are known [1,2]. It has been well known that these derivatives of N-acetylneuraminic acid must play an improtant part in various biological processes [3]. In recent years, N-acetylneuraminic acid as anti-influenza drugs and as a detection regent of influenza virus has attracted much attention [4,5]. Herein, 8,9-O-isopropylidine-Neu5Ac-methylester-methylketoside, as a derivative of sialic acid has been synthesized, and its crystal structure has been described.The unit cell of this compound contains four 8,9-O-isopropylidine Neu5Ac methyl ester methyl ketoside molecules. In this molecular structure, there are a five number 1,3-dioxolane ring and a six number pyran cycle. In the crystal structure, there are intramolecular hydrogen bonds between O7 and O6 with the distance O7···O6 of 2.753(3) Å and the angles N1–H99···O4 being 149.7°. In addition, there are intermolecular hydrogen bonds between N1 and O7 (symmetry code: x, y-1, z) with the distance N1···O7 of 2.847(3) Å and the angles N1–H99···O being 163.0°, as well as the hydrogen bonds between O5 and O6 (symmetry code: -x+1/2, y-1/2, -z+1) with the distance O5–H5···O6 of 2.862(3) Å and the angles N1–H99···O7 being 154.1°, which interlink molecules to form a 1D supramolecular structure. The absorption bands at 2942, 2836, 1738, 1156 cm^{-1} in the IR spectra of this compound is attributed to the characteristic vibrations of C–H bonds of the methyl group, the C–H bonds of the methoxyl group, C=O bond of the carbonyl group, the C–O bond of the ether group. In addition, two strong absorptions at 1624 and 1578 cm^{-1} are assigned to vibrations of the acylamide group.

Table 2. Atomic coordinates and displacement parameters (in Å^2).

Atom	Site	*x*	*y*	*z*	U_{iso}
H(6A)	4*c*	0.2527	0.4533	0.0643	0.121
H(6B)	4*c*	0.2723	0.6649	0.1254	0.121
H(6C)	4*c*	0.2025	0.6581	0.0178	0.121
H(7A)	4*c*	0.0722	1.2687	–0.0348	0.206
H(7B)	4*c*	0.0123	1.0896	–0.0715	0.206
H(7C)	4*c*	0.0682	1.0732	–0.0955	0.206
H(9A)	4*c*	0.3492	0.2432	0.5758	0.067
H(9B)	4*c*	0.3878	0.4335	0.6493	0.067
H(9C)	4*c*	0.4156	0.3588	0.5911	0.067
H(14A)	4*c*	0.4738	0.6947	0.2725	0.200
H(14B)	4*c*	0.4915	0.6988	0.3750	0.200
H(14C)	4*c*	0.5395	0.8329	0.3552	0.200
H(16A)	4*c*	0.4219	1.0001	0.1688	0.172
H(16B)	4*c*	0.4864	1.1478	0.2478	0.172
H(16C)	4*c*	0.4054	1.2130	0.2019	0.172
H(99)	4*c*	0.2954	0.3497	0.4068	0.052
H(5)	4*c*	0.1544	0.3089	0.3371	0.097
H(1)	4*c*	0.2912	0.5995	0.2734	0.043
H(2)	4*c*	0.2107	0.7044	0.3449	0.042
H(3)	4*c*	0.1909	0.3127	0.2447	0.051
H(4A)	4*c*	0.0831	0.4549	0.1106	0.057
H(4B)	4*c*	0.0909	0.6657	0.1668	0.057
H(11)	4*c*	0.3664	0.8069	0.4079	0.046
H(12)	4*c*	0.3022	1.1113	0.2542	0.054
H(13A)	4*c*	0.3993	1.3242	0.3484	0.064
H(13B)	4*c*	0.4155	1.1877	0.4365	0.064
H(7)	4*c*	0.2830	0.9467	0.4197	0.066

Table 3. Atomic coordinates and displacement parameters (in Å^2).

Atom	Site	Occ.	*x*	*y*	*z*	U_{11}	U_{22}	U_{33}	U_{12}	U_{13}	U_{23}
C(6)	4*c*		0.2330(3)	0.575(1)	0.0760(3)	0.073(3)	0.116(4)	0.064(2)	–0.007(3)	0.047(2)	–0.015(3)
C(7)	4*c*		0.0618(5)	1.117(1)	–0.0479(4)	0.174(6)	0.075(4)	0.066(3)	0.011(5)	0.020(4)	0.024(3)
C(8)	4*c*		0.1045(2)	0.7941(7)	0.0340(2)	0.054(2)	0.057(2)	0.037(2)	–0.008(2)	0.017(1)	0.004(2)
C(9)	4*c*		0.3700(2)	0.3882(6)	0.5844(2)	0.041(2)	0.045(2)	0.037(2)	0.000(2)	0.018(1)	0.008(1)
C(10)	4*c*		0.3184(2)	0.5443(5)	0.5048(2)	0.034(1)	0.034(2)	0.037(1)	–0.001(1)	0.021(1)	0.002(1)
C(14)	4*c*		0.4910(4)	0.783(2)	0.3280(6)	0.087(4)	0.133(6)	0.159(5)	0.026(4)	0.063(4)	–0.005(5)
C(16)	4*c*		0.4386(4)	1.094(2)	0.2226(4)	0.109(4)	0.154(6)	0.089(3)	–0.039(4)	0.064(3)	0.003(4)
N(1)	4*c*		0.2862(1)	0.4727(4)	0.4149(2)	0.041(1)	0.026(1)	0.037(1)	0.002(1)	0.023(1)	0.001(1)
O(2)	4*c*		0.1910(2)	0.5012(5)	0.1065(2)	0.071(2)	0.067(2)	0.060(2)	–0.007(2)	0.039(1)	–0.019(1)
O(3)	4*c*		0.0601(2)	0.6975(7)	–0.0391(2)	0.094(2)	0.092(3)	0.053(2)	–0.012(2)	0.011(2)	0.004(2)
O(4)	4*c*		0.1115(3)	0.9936(6)	0.0406(2)	0.139(4)	0.063(2)	0.054(2)	0.002(2)	0.004(2)	0.005(2)
O(5)	4*c*		0.1282(1)	0.3733(6)	0.2856(2)	0.045(1)	0.086(2)	0.055(1)	–0.014(1)	0.025(1)	0.022(1)
O(6)	4*c*		0.3080(1)	0.7297(4)	0.5221(2)	0.058(1)	0.041(1)	0.040(1)	0.006(1)	0.029(1)	–0.0025(9)
C(1)	4*c*		0.2667(2)	0.7080(5)	0.2862(2)	0.036(1)	0.036(1)	0.034(1)	0.001(1)	0.0200(9)	–0.001(1)
C(2)	4*c*		0.2318(2)	0.5936(5)	0.3277(2)	0.035(1)	0.034(1)	0.035(1)	0.004(1)	0.021(1)	0.000(1)
C(3)	4*c*		0.1703(2)	0.4397(6)	0.2545(2)	0.040(1)	0.040(2)	0.042(1)	–0.005(1)	0.021(1)	0.002(1)
C(4)	4*c*		0.1179(2)	0.5576(7)	0.1592(2)	0.040(1)	0.050(2)	0.041(1)	–0.008(1)	0.018(1)	0.003(1)
C(5)	4*c*		0.1583(2)	0.6653(6)	0.1264(2)	0.043(1)	0.048(2)	0.036(1)	–0.004(1)	0.019(1)	0.001(1)
C(11)	4*c*		0.3225(2)	0.8804(5)	0.3541(2)	0.037(1)	0.036(1)	0.038(1)	–0.001(1)	0.020(1)	–0.003(1)
C(12)	4*c*		0.3444(2)	1.0271(6)	0.3052(2)	0.041(1)	0.045(2)	0.046(1)	–0.006(1)	0.025(1)	–0.003(1)
C(13)	4*c*		0.4080(2)	1.1796(7)	0.3752(3)	0.046(2)	0.050(2)	0.060(2)	–0.010(2)	0.030(1)	–0.007(2)
C(15)	4*c*		0.4422(2)	0.9698(7)	0.2991(3)	0.046(2)	0.064(2)	0.058(2)	–0.007(2)	0.032(1)	–0.005(2)
O(1)	4*c*		0.2117(1)	0.8134(4)	0.1978(1)	0.0414(9)	0.0379(9)	0.0357(8)	–0.0034(7)	0.0201(7)	0.0014(7)
O(7)	4*c*		0.2954(1)	1.0199(4)	0.3923(2)	0.062(1)	0.027(1)	0.052(1)	–0.002(1)	0.039(1)	–0.0039(9)
O(8)	4*c*		0.3715(1)	0.8973(6)	0.2653(2)	0.055(1)	0.083(2)	0.083(2)	–0.027(2)	0.051(2)	–0.032(2)
O(9)	4*c*	0.54	0.4677(7)	1.083(3)	0.3857(7)	0.049(4)	0.092(7)	0.039(5)	–0.006(5)	0.019(4)	–0.005(6)
O(9A)	4*c*	0.46	0.459(2)	1.145(9)	0.360(5)	0.054(9)	0.15(2)	0.11(2)	–0.06(1)	0.06(1)	–0.07(2)

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