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for

Anti-Carbohydrate Antibodies Elicited by Polyvalent Display on a Viral Scaffold

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References

More complete list of references to the polyvalent display of carbohydrates.

Dendrimers: [1-6]
Polymers made by ring-opening metathesis polymerization: [7-15]
Polymers made by other technologies: [8,14,16]
Liposomes: [17-19]
Polyacrylamides: [20-23]
Amino acids: [24,25]
Small organic molecules fitted for a specific binding site: [18,26]

Papers from Danishefsky and coworkers on the development of anti-glycan vaccines: [27-36]

More complete list of references to the structure and manipulation of CPMV.

Isolation and purification: [37-39]
X-ray structure at 2.8 Å resolution: [40]
Thermal stability: [41]
Infectious plasmid: [42]
Peptide epitopes displayed on surface: [38,43]
Chemical derivatization via lysine,[44,45] tyrosine,[46] and cysteine[47] residues

More complete list of references to anti-glycan IgY antibodies and affinity purification.

Anti-glycan IgY: [48-51]
Immunization of mice has yielded several monoclonal antibodies specific for some carbohydrates; most, but not all,52 are of the IgM class.
Affinity purification of anti-carbohydrate antibodies: [48,51,53,54]

*Referencing describing relevance of glycans **1-4**.*

1 = blood group A antigen recognized by galectin-4,[55] which is overexpressed in several cancer lines and is thought to be associated with metastatic events.[56-58]
2 = tri-LacNAc recognized by several members of the galectin family of receptors upregulated in breast and colon cancers; [59,60]
3 = sialyl LewisX, a well known participant in a variety of important cellular binding and signaling events;[61]
4 = globo-H, an important cancer marker and immunogen.[62,63]

Synthetic procedures

Materials

The following were obtained from the indicated sources: white leghorn hens, 3-6 months old (McIntyre Farms, San Diego, CA); monoclonal antibody ALX-804-550, α-globo-H (Axorra, LLC, San Diego); goat-α-IgY-FITC and total IgY purification service (Genway, Biotech., San Diego); rabbit-α-mouse IgG/IgM/IgA-FITC (Abcam, Inc., Cambridge, MA); CarboxyLink resin, 4% (Pierce Biotechnology, Inc., Rockford, IL). All aspects of the care and handling of the chickens were performed in accordance with national and local guildelines, under the supervision of the TSRI Institutional Animal Care and Use Committee.

Carbohydrate syntheses

Carbohydrates **1-4** were prepared as 2-azidoethanol β-anomeric adducts by enzymatic and chemical synthesis as previously described.[14, 15] A representative example (compound **1**) of the last step and purification is given in the Experimental section. The ^{1}H NMR (500 MHz, D_2O) spectrum of **1** is shown in Figure S1.

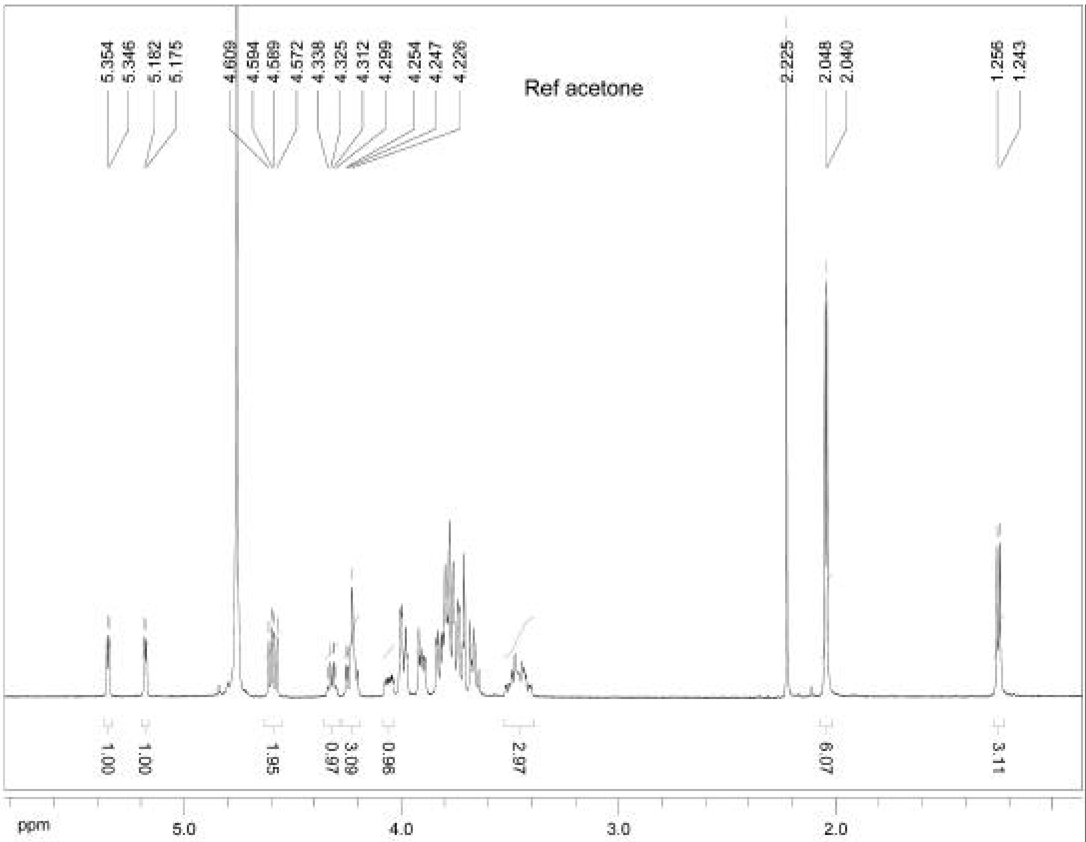


Figure S1. ^{1}H NMR spectrum of **1**.

Procedure for immobilization of tri- and mono-LacNAc for affinity purification: Stock solutions (50 mM) of the following reagents were prepared: 2,6-lutidine (DMF), 2,2'-bipyridine (DMF), CuBr (DMF), and sodium ascorbate (water). A slurry of agarose-alkyne beads[64] (1.0 equiv) in DMF in a disposable frit was treated with carbohydrate-azide (4.0 equiv), followed by 2,6-lutidine (8.0 equiv), 2,2'-bipyridine (8.0 equiv), cuprous bromide (4.0 equiv), and finally sodium ascorbate (8.0 equiv). The resulting suspension was bubbled with a gentle flow of nitrogen for 1 min, capped, and rotated at room temperature for 12-18 h. The reaction mixture was drained and washed sequentially with approximately 5 column volumes each of DMF, H_2O, MeOH, 0.1 M aq EDTA, H_2O and DMF to obtain carbohydrate-agarose beads. A parallel experiment with a dye-azide under otherwise identical conditions provided highly colored beads confirming a positive reaction.

*KLH and BSA conjugates **16** and **17***

Bovine serum albumin (BSA) and keyhole limpet hemocyanin (KLH) at 4 mg/mL in 0.1 M phosphate buffer (pH 7.0) were treated with 335 equiv. of NHS-alkyne linker **6**. The reactions were agitated by gentle rocking overnight at room temperature and the products purified by two rounds of dialysis in 1 liter of distilled H_2O. The resulting conjugates were degassed by gentle N_2 sparging before storing in under nitrogen atmosphere. Fluorescein-azide and tri-LacNAc-azide (**2**) were joined with these alkyne-derivatized proteins under the same conditions as used for **12** and **13** (2 mg/mL protein, 0.3 mM azide, 1 mM CuOTf , 2 mM ligand **10**, in 0.1M Tris buffer, pH 8). Each conjugate was allowed to proceed under nitrogen for 18 hours at room temperature and purified by dialysis as described above. Both KLH-alkyne and BSA-alkyne reactions with fluorescein-azide produced bright yellow protein conjugates; the BSA reaction was performed in order to verify the success of attachment methodology by MALDI-TOF mass spectrometry: BSA, observed m/z = 66,000; BSA-fluorescein, observed m/z = 93700 (fluorescein-liner = 640 Da, 43 fluoresceins per BSA); BSA-**2** (conjugate **17**), observed m/z = 104,400 (glycan-linker = 1335 Da, 29 glycans per BSA).

Chicken Immunization

White Leghorn hens (3-6 months old) were immunized with 200 μg of the appropriate virus-glycan conjugate; Freund's complete adjuvant (CFA) was co-injected with the initial dose. Hens were boosted with an additional 100 μg of CPMV conjugate and incomplete Freund's adjuvant (IFA) on days 14, 28, and 49. Eggs were collected and cataloged from days 24 to 70. The final 12 eggs from each bird were pooled; isolation of total IgY by Genway Biotech (San Diego, CA) provided approximately one gram of polyclonal antibody per chicken. As a control, wild type CPMV was incubated with CFA and IFA overnight at the same concentrations used for immunization. These samples were dialyzed and found by size-exclusion chromatography to contain exclusively fully intact virions and to have lost no material to precipitation (data not shown).

Polyclonal IgY affinity purification

Agarose beads functionalized with either tri- or mono-LacNAc were prepared by azide-alkyne cycloaddition as previous described.[24] For each IgY sample to be purified, 50 mg was incubated for 12 hours with 3 mL of beaded agarose bearing compound **18** attached at approximately 60% of the total number of sites on the support.[24] The mixture was poured into a small column and the "flowthrough" fraction collected. The column was then washed with approximately 100 mL of standard buffer (PBS, pH 7.4) and then with 0.1M glycine buffer (pH 2, 5 mL, "elution" fraction) which was immediately neutralized in 1.0 M Tris-HCl buffer (pH 8.0). The flowthrough fraction was re-incubated in the mono-LacNAc agarose column for 1 hour and eluted in the same fashion twice more to ensure maximum yield of tri-LacNAc specific antibodies. After three such rounds, the elution fractions were pooled and concentrated to 1 mg/mL for analysis on the glycan array. The concentrated "wash" fractions contained no protein as determined by uv-vis spectroscopy.

*Loading of carbohyrate **2** on CPMV and KLH*

The attachment of **2** to CPMV (conjugate **15**, 80 ± 8 attached molecules per virion) was quantified by comparison to otherwise identical reactions using a fluorescein-azide derivative. Because KLH is a heterogeneous aggregate, the number of attached molecules of **2** in conjugate **16** could not be determined, but we presume that the loading was high, based on identical side-by-side reactions with bovine serum albumin to give **17**, which was analyzed by MALDI mass spectrometry (Figure S2, below). In addition, reaction of KLH with fluorescein-azide under otherwise identical conditions gave brightly colored protein after two rounds of dialysis.

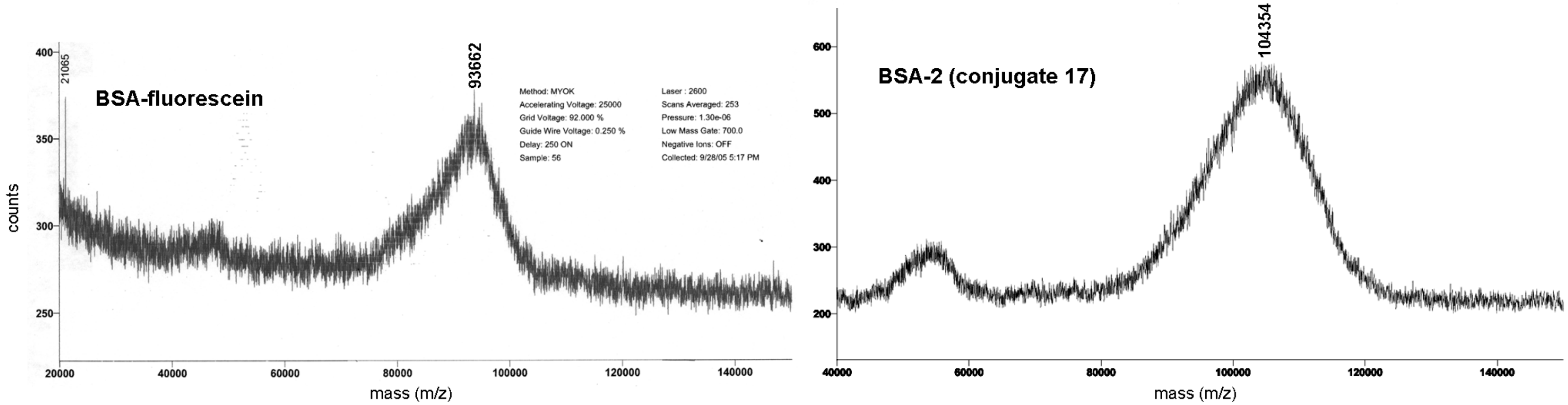


Figure S2. MALDI-TOF mass spectra of BSA conjugates.

Pre-immune IgY

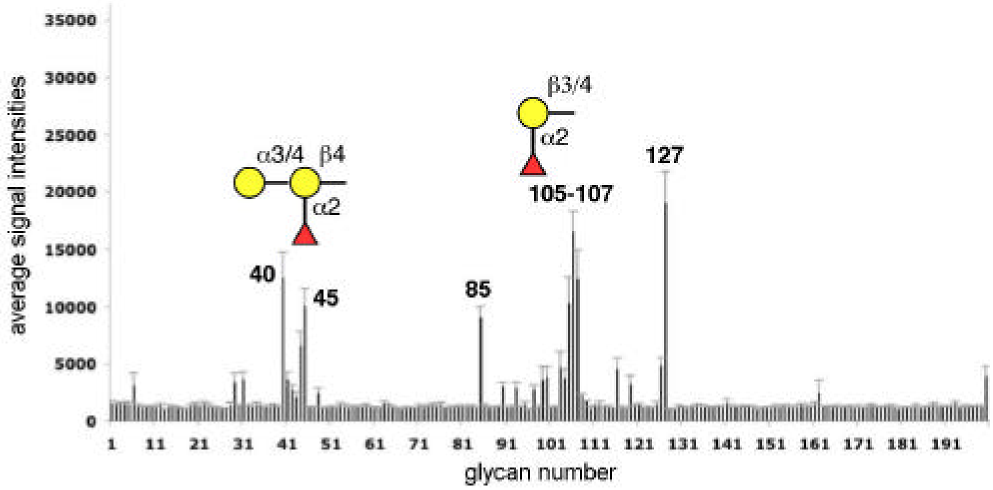


Figure S3. Glycan array binding analysis (array v1.0) of crude IgY isolated from eggs prior to immunization.

Reproducibility

Conjugates **15** and **16** were separately administered to two chickens, and the IgY isolated from each was analyzed separately. Figure S4 shows the ratios of absolute signal intensities for these independent experiments involving each antigen; Tables S1 and S2 contain the numerical data for these plots. For glycans showing significant antibody binding (>20% of the maximum value in each analysis), the absolute signal intensities for the independent trials were generally within a factor of 4 of each other, and often within a factor of 2. None of the glycans showing less reproducible recognition contained the unsubstituted LacNAc epitope that is the major recognition motif of the antigen. Note that the anomalously large signals for anti-**15** were all generated in one of the two experiments, suggesting not random error, but rather an error in one analysis that did not occur in the other. Possibilities include a few spots in one of the array slides receiving a higher than expected concentration of glycan, or a stronger immune response of one chicken compared to the other, somehow distributed over only a few antibodies. The single anomalous response observed in the analysis of anti-**16** derived from an unusually large reading in one of the two array analyses, and so it is impossible to speculate on its cause.

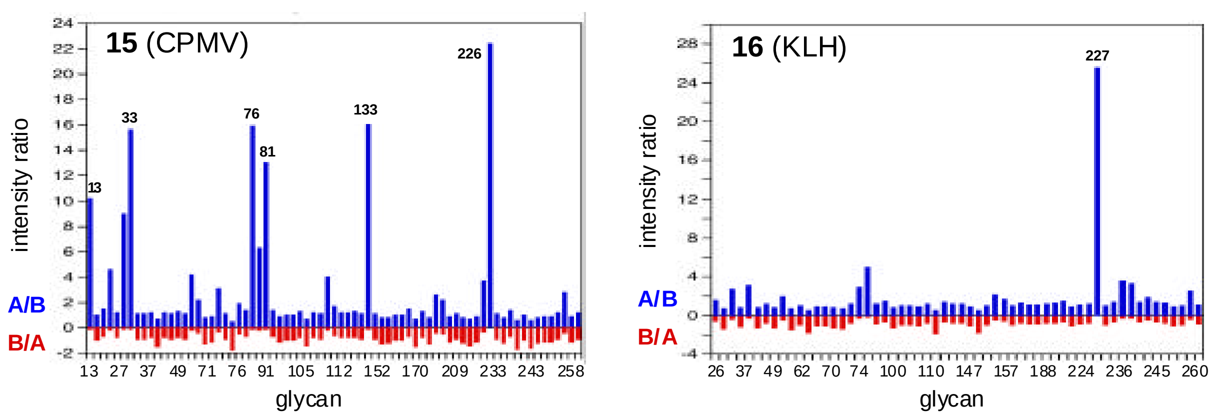


Figure S4. Plots of ratios of significant signals (>20% of the maximum) from glycan array (v2.0) analyses of total IgY generated by different chickens (designated A and B) against (*left*) CPMV conjugate **15** and (*right*) KLH conjugate **16**. Numerical data for these plots can be found in Supporting Information. Glycans exhibiting a greater than 10-fold difference in absolute signal intensity from one experiment to the other are labeled with the following numbers: 13 = α-L-Rha–linker; 33 = [3-OSO_3]Galβ1-3GlcNAcβ–linker; 76 = Fucα1-3GlcNAcβ–linker; 81 = GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ-linker; 133 = Galβ1-3GlcNAcβ–linker; 226 = Neu5Acα2-3Galβ1-3GlcNAcβ–linker; 227 = Neu5Acα2-3Galβ1-4[6-OSO_3]GlcNAcβ-linker.

Figure S5 shows a repeat of the generation and analysis of anti-**14** (globo-H on CPMV). Again, very good reproducibility was observed.

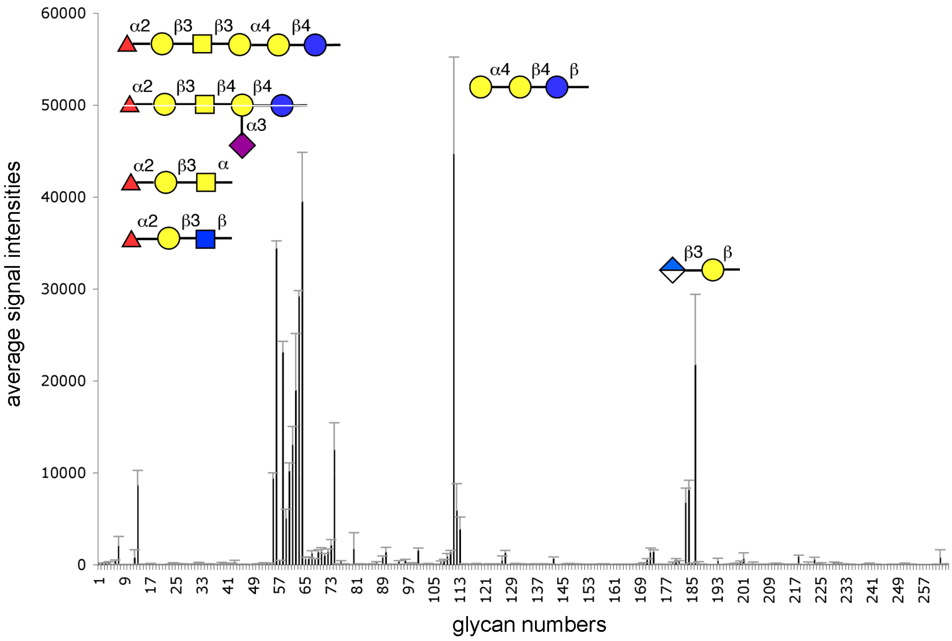


Figure S5. Independent repeat of the experiment described in Figure 3 of the main text, showing glycan array (v2.0) binding analysis of anti-**14** IgY. The only significant difference between these data and the analysis shown in Figure 3 is the strong response to globoside Galα1-4)Galβ1-4)Glc (glycan 111).

A comparison of the average strong signal intensities for anti-**15** vs. anti-**16** total IgY is shown in Figure S6 (numerical data in Table S3); comparison of the weaker signals is shown in Figure S7 (numerical data in Table S4). For five strongly-recognized glycans and approximately a dozen weakly-recognized glycans, the detection signal was more than 50-fold better with antibody derived from immunization with CPMV **15**, and only one (probably anomalous; see Fig. S5) signal from KLH **16** was correspondingly more intense than its CPMV counterpart. We do not know if the greater potency of anti-**15** vs. anti-**16** IgY observed for certain glycans is the result of stronger binding affinities or greater relative concentrations of the specific glycan-binding members of the polyclonal library. While these results suggest that CPMV can elicit at least some more potent IgY molecules than does KLH, a firm conclusion must await additional experiments.

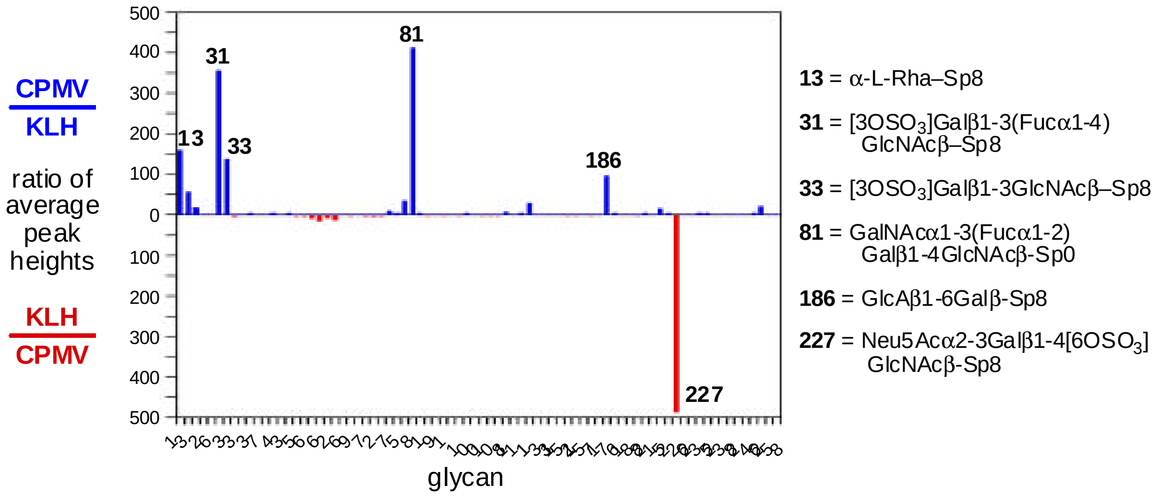


Figure S6. Plots of ratios of averaged signals from glycan array (v2.0) analyses of total IgY generated by two different chickens against CPMV conjugate **15** *vs.* KLH conjugate **16**; all IgY samples were used at 0.1 mg/mL. To the right are the structures of the glycans exhibiting a greater than 100-fold difference in absolute signal intensity comparing anti-**15** to anti-**16** or *vice versa.* For clarity, not all of the glycan numbers are shown on the x-axis.

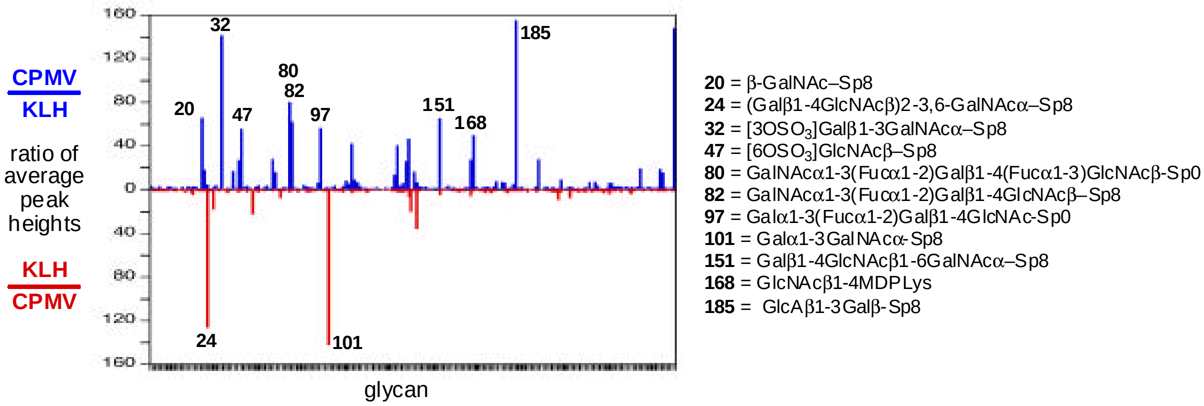


Figure S7. Plots of ratios of low-intensity signals (≤20% of the maximum) from glycan array (v2.0) analyses of total IgY generated by two different chickens against CPMV conjugate **15** and KLH conjugate **16**. Numerical data for this plot can be found in Table S4. To the right are the structures of the glycans exhibiting a greater than 50-fold difference in absolute signal intensity comparing anti-**15** to anti-**16** or *vice versa*.

Table S1. Test of reproducibility in IgY generation and glycan array analysis (v2.0) for total IgY derived from immunization with **15** (CPMV display; Figure S4). Samples derived from two different chickens are designated “exp. A” and “exp. B.”

Glycans giving average signals >20% of maximum intensity, ordered by glycan number.

Glycan #	signal for exp. A	signal for exp. B	ratio A/B	ratio B/A	Glycan structure
13	25643	2509	10.2	0.1	α-L-Rhα–Sp8
21	52440	53039	1.0	1.0	β-GlcNAc–Sp0
22	46609	30789	1.5	0.7	β-GlcNAc–Sp8
26	54005	11797	4.6	0.2	[3OSO$_3$][6OSO$_3$]Galβ1-4[6OSO$_3$]GlcNAcβ-Sp0
27	43507	36067	1.2	0.8	[3OSO$_3$][6OSO$_3$]Galβ1-4GlcNAcβ-Sp0
31	22178	2451	9.0	0.1	[3OSO$_3$]Galβ1-3(Fucα1-4)GlcNAcβ–Sp8
33	45774	2939	15.6	0.1	[3OSO$_3$]Galβ1-3GlcNAcβ–Sp8
35	11497	10533	1.1	0.9	[3OSO$_3$]Galβ1-4[6OSO$_3$]GlcNAcβ-Sp8
36	56195	50143	1.1	0.9	[3OSO$_3$]Galβ1-4GlcNAcβ–Sp0
37	47287	39840	1.2	0.8	[3OSO$_3$]Galβ1-4GlcNAcβ-Sp8
39	40922	62802	0.7	1.5	[4OSO$_3$][6OSO$_3$]Galβ1-4GlcNAcβ-Sp0
40	39757	33315	1.2	0.8	[4OSO$_3$]Galβ1-4GlcNAcβ-Sp8
43	12108	10738	1.1	0.9	[6OSO$_3$]Galβ1-4Glcβ–Sp8
44	45228	34412	1.3	0.8	[6OSO$_3$]Galβ1-4GlcNAcβ–Sp8
49	41913	39750	1.1	0.9	9NAcNeu5Acα2-6Galβ1-4GlcNAcβ-Sp8
56	30937	7321	4.2	0.2	Fucα1-2Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ-Sp9
58	28129	12520	2.2	0.4	Fucα1-2Galβ1-3GalNAcα–Sp8
69	42962	56185	0.8	1.3	Fucα1-2Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAc–Sp0
70	32943	35788	0.9	1.1	Fucα1-2Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
71	32211	10428	3.1	0.3	Fucα1-2Galβ1-4GlcNAcβ–Sp0
72	16844	15963	1.1	0.9	Fucα1-2Galβ1-4GlcNAcβ–Sp8
73	9257	16837	0.5	1.8	Fucα1-2Galβ1-4Glcβ–Sp0
74	19334	10429	1.9	0.5	Fucα1-2Galβ–Sp8
75	49567	35712	1.4	0.7	Fucα1-2GlcNAcβ-Sp8
76	39446	2481	15.9	0.1	Fucα1-3GlcNAcβ–Sp8
77	17727	2805	6.3	0.2	Fucα1-4GlcNAcβ–Sp8
81	37084	2847	13.0	0.1	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ-Sp0
89	14242	10452	1.4	0.7	GalNAcβ1-3(Fucα1-2)Galβ-Sp8
90	34682	38375	0.9	1.1	GalNAcβ1-3Galα1-4Galβ1-4GlcNAcβ-Sp0
91	11310	11430	1.0	1.0	GalNAcβ1-4(Fucα1-3)GlcNAcβ-Sp0
92	42253	44091	1.0	1.0	GalNAcβ1-4GlcNAcβ–Sp0
93	43524	34757	1.3	0.8	GalNAcβ1-4GlcNAcβ–Sp8
100	29939	42157	0.7	1.4	Galα1-3(Galα1-4)Galβ1-4GlcNAcβ-Sp8
104	13288	10743	1.2	0.8	Galα1-3Galβ1-3GlcNAcβ-Sp0
105	39729	37678	1.1	0.9	Galα1-3Galβ1-4GlcNAcβ–Sp8
108	20806	5184	4.0	0.2	Galα1-4(Fucα1-2)Galβ1-4GlcNAcβ-Sp8
109	47906	28757	1.7	0.6	Galα1-4Galβ1-4GlcNAcβ–Sp0
110	49454	40535	1.2	0.8	Galα1-4Galβ1-4GlcNAcβ–Sp8
111	33390	26843	1.2	0.8	Galα1-4Galβ1-4Glcβ–Sp0
112	36600	28128	1.3	0.8	Galα1-4GlcNAcβ–Sp8
131	40329	36229	1.1	0.9	Galβ1-3GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
133	26070	1632	16.0	0.1	Galβ1-3GlcNAcβ–Sp0
146	55491	50234	1.1	0.9	Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0
147	35510	47113	0.8	1.3	Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0
152	39802	47454	0.8	1.2	Galβ1-4GlcNAcβ–Sp0
153	42091	41712	1.0	1.0	Galβ1-4GlcNAcβ–Sp8
156	44344	44298	1.0	1.0	GlcNAcα1-3Galβ1-4GlcNAcβ-Sp8

Glycan #	signal for exp. A	signal for exp. B	ratio A/B	ratio B/A	Glycan structure
157	36591	24478	1.5	0.7	GlcNAcα1-6Galβ1-4GlcNAcβ-Sp8
166	34086	50710	0.7	1.5	GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
170	43019	33623	1.3	0.8	GlcNAcβ1-4Galβ1-4GlcNAcβ-Sp8
176	32934	42085	0.8	1.3	GlcNAcβ1-6Galβ1-4GlcNAcβ-Sp8
186	33529	13066	2.6	0.4	GlcAβ1-6Galβ-Sp8
187	39994	18410	2.2	0.5	KDNα2-3Galβ1-3GlcNAcβ–Sp0
188	37430	40623	0.9	1.1	KDNα2-3Galβ1-4GlcNAcβ–Sp0
209	51542	46240	1.1	0.9	Neu5Acα2-3(GalNAcβ1-4)Galβ1-4GlcNAcβ-Sp0
210	29398	35884	0.8	1.2	Neu5Acα2-3(GalNAcβ1-4)Galβ1-4GlcNAcβ-Sp8
215	32798	45686	0.7	1.4	Neu5Acα2-3GalNAcβ1-4GlcNAcβ-Sp0
224	37570	40245	0.9	1.1	NeuAcα2-3Galβ1-3GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
225	17338	4723	3.7	0.3	Neu5Acα2-3Galβ1-3GlcNAcβ–Sp0
226	26344	1178	22.4	0.0	Neu5Acα2-3Galβ1-3GlcNAcβ–Sp8
233	40739	36948	1.1	0.9	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp8
235	40677	49031	0.8	1.2	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0
236	46775	34349	1.4	0.7	Neu5Acα2-3Galβ1-4GlcNAcβ–Sp0
237	29180	49161	0.6	1.7	Neu5Acα2-3Galβ1-4GlcNAcβ–Sp8
238	46625	46104	1.0	1.0	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
243	29110	47050	0.6	1.6	Neu5Acα2-6GalNAcβ1-4GlcNAcβ-Sp0
245	43960	53581	0.8	1.2	Neu5Acα2-6Galβ1-4GlcNAcβ–Sp0
246	31461	33220	0.9	1.1	Neu5Acα2-6Galβ1-4GlcNAcβ–Sp8
248	27400	30043	0.9	1.1	Neu5Acα2-6Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
255	47102	40448	1.2	0.9	Neu5Acβ2-6Galβ1-4GlcNAcβ-Sp8
258	33331	11736	2.8	0.4	Neu5Gcα2-3Galβ1-3GlcNAcβ-Sp0
260	35885	38815	0.9	1.1	Neu5Gcα2-3Galβ1-4GlcNAcβ–Sp0
263	42659	36762	1.2	0.9	Neu5Gcα2-6Galβ1-4GlcNAcβ–Sp0

Table S2. Test of reproducibility in IgY generation and glycan array analysis (v2.0) for total IgY derived from immunization with **16** (KLH display; Figure S4). Samples derived from two different chickens are designated "exp. A" and "exp. B."

Glycans giving average signals >20% of maximum intensity, ordered by glycan number.

Glycan #	signal for exp. A	signal for exp. B	ratio A/B	ratio B/A	Glycan structure
26	39480	24340	1.6	0.6	[3OSO$_3$][6OSO$_3$]Galβ1-4[6OSO$_3$]GlcNAcβ-Sp0
27	29227	40593	0.7	1.4	[3OSO$_3$][6OSO$_3$]Galβ1-4GlcNAcβ-Sp0
35	43268	16070	2.7	0.4	[3OSO$_3$]Galβ1-4[6OSO$_3$]GlcNAcβ-Sp8
36	37988	45518	0.8	1.2	[3OSO$_3$]Galβ1-4GlcNAcβ–Sp0
37	20934	6746	3.1	0.3	[3OSO$_3$]Galβ1-4GlcNAcβ-Sp8
39	36764	45964	0.8	1.3	[4OSO$_3$][6OSO$_3$]Galβ1-4GlcNAcβ-Sp0
40	39335	32309	1.2	0.8	[4OSO$_3$]Galβ1-4GlcNAcβ-Sp8
44	27418	35969	0.8	1.3	[6OSO$_3$]Galβ1-4GlcNAcβ–Sp8
49	19043	9655	2.0	0.5	9NAcNeu5Acα2-6Galβ1-4GlcNAcβ-Sp8
56	30584	44429	0.7	1.5	Fucα1-2Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ-Sp9
58	43176	41569	1.0	1.0	Fucα1-2Galβ1-3GalNAcα–Sp8
61	23786	43605	0.5	1.8	Fucα1-2Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ–Sp10
62	29511	33572	0.9	1.1	Fucα1-2Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ–Sp8
63	35149	37576	0.9	1.1	Fucα1-2Galβ1-3GlcNAcβ–Sp0
64	22465	29216	0.8	1.3	Fucα1-2Galβ1-3GlcNAcβ–Sp8
69	37349	52975	0.7	1.4	Fucα1-2Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAc–Sp0
70	42472	35833	1.2	0.8	Fucα1-2Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-

Glycan #	signal for exp. A	signal for exp. B	ratio A/B	ratio B/A	Glycan structure
					3Galβ1-4GlcNAcβ-Sp0
71	22391	7822	2.9	0.3	Fucα1-2Galβ1-4GlcNAcβ–Sp0
72	53364	10703	5.0	0.2	Fucα1-2Galβ1-4GlcNAcβ–Sp8
73	41923	35888	1.2	0.9	Fucα1-2Galβ1-4Glcβ–Sp0
74	34850	23163	1.5	0.7	Fucα1-2Galβ–Sp8
90	41087	52761	0.8	1.3	GalNAcβ1-3Galα1-4Galβ1-4GlcNAcβ-Sp0
92	51136	49951	1.0	1.0	GalNAcβ1-4GlcNAcβ–Sp0
93	40941	41131	1.0	1.0	GalNAcβ1-4GlcNAcβ–Sp8
100	38993	41840	0.9	1.1	Galα1-3(Galα1-4)Galβ1-4GlcNAcβ-Sp8
105	37703	31997	1.2	0.8	Galα1-3Galβ1-4GlcNAcβ–Sp8
108	10357	19176	0.5	1.9	Galα1-4(Fucα1-2)Galβ1-4GlcNAcβ-Sp8
109	58168	41451	1.4	0.7	Galα1-4Galβ1-4GlcNAcβ–Sp0
110	52197	42691	1.2	0.8	Galα1-4Galβ1-4GlcNAcβ–Sp8
112	23971	19855	1.2	0.8	Galα1-4GlcNAcβ–Sp8
131	17844	19039	0.9	1.1	Galβ1-3GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
146	30959	56431	0.5	1.8	Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0
147	35100	36570	1.0	1.0	Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0
152	49714	23960	2.1	0.5	Galβ1-4GlcNAcβ–Sp0
153	46557	27037	1.7	0.6	Galβ1-4GlcNAcβ–Sp8
156	51110	50473	1.0	1.0	GlcNAcα1-3Galβ1-4GlcNAcβ-Sp8
157	39996	30209	1.3	0.8	GlcNAcα1-6Galβ1-4GlcNAcβ-Sp8
166	44997	40640	1.1	0.9	GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
170	46674	40654	1.1	0.9	GlcNAcβ1-4Galβ1-4GlcNAcβ-Sp8
176	41812	33723	1.2	0.8	GlcNAcβ1-6Galβ1-4GlcNAcβ-Sp8
188	39257	31168	1.3	0.8	KDNα2-3Galβ1-4GlcNAcβ–Sp0
209	48090	32827	1.5	0.7	Neu5Acα2-3(GalNAcβ1-4)Galβ1-4GlcNAcβ-Sp0
210	37474	41762	0.9	1.1	Neu5Acα2-3(GalNAcβ1-4)Galβ1-4GlcNAcβ-Sp8
215	25628	22622	1.1	0.9	Neu5Acα2-3GalNAcβ1-4GlcNAcβ-Sp0
224	40629	34403	1.2	0.8	NeuAcα2-3Galβ1-3GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
227	49542	1933	25.6	0.0	Neu5Acα2-3Galβ1-4[6OSO$_3$]GlcNAcβ-Sp8
233	40186	41367	1.0	1.0	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp8
235	41814	29294	1.4	0.7	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0
236	33548	9448	3.6	0.3	Neu5Acα2-3Galβ1-4GlcNAcβ–Sp0
237	17925	5391	3.3	0.3	Neu5Acα2-3Galβ1-4GlcNAcβ–Sp8
238	47277	33162	1.4	0.7	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
243	40768	21386	1.9	0.5	Neu5Acα2-6GalNAcβ1-4GlcNAcβ-Sp0
245	53016	39072	1.4	0.7	Neu5Acα2-6Galβ1-4GlcNAcβ–Sp0
246	23550	18202	1.3	0.8	Neu5Acα2-6Galβ1-4GlcNAcβ–Sp8
248	25860	29446	0.9	1.1	Neu5Acα2-6Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
255	20122	20064	1.0	1.0	Neu5Acβ2-6Galβ1-4GlcNAcβ-Sp8
260	35576	13963	2.5	0.4	Neu5Gcα2-3Galβ1-4GlcNAcβ–Sp0
263	32193	30390	1.1	0.9	Neu5Gcα2-6Galβ1-4GlcNAcβ–Sp0

Table S3 (data for Figure S6; comparison of CPMV and KLH platforms). Glycan array analysis (v2.0) for total IgY derived from immunization with **15** vs. **16**. Average signals are derived from the independent experiments listed in Tables S1 and S2.

*Glycans giving average signals >20% of maximum intensity for either anti-**15** or anti-**16**, ordered by glycan number.*

Glycan #	avg. signal for anti-15	avg. signal for anti-16	ratio 15/16	ratio 16/15	Glycan structure
13	14076	88	159.8	0.0	α-L-Rhα–Sp8
21	52740	950	55.5	0.0	β-GlcNAc–Sp0
22	38699	2177	17.8	0.1	β-GlcNAc–Sp8
26	32901	31910	1.0	1.0	[3OSO$_3$][6OSO$_3$]Galβ1-4[6OSO$_3$]GlcNAcβ-Sp0
27	39787	34910	1.1	0.9	[3OSO$_3$][6OSO$_3$]Galβ1-4GlcNAcβ-Sp0
31	12315	35	356.8	0.0	[3OSO$_3$]Galβ1-3(Fucα1-4)GlcNAcβ–Sp8
33	24357	178	137.1	0.0	[3OSO$_3$]Galβ1-3GlcNAcβ–Sp8
35	11015	29669	0.4	2.7	[3OSO$_3$]Galβ1-4[6OSO$_3$]GlcNAcβ-Sp8
36	53169	41753	1.3	0.8	[3OSO$_3$]Galβ1-4GlcNAcβ–Sp0
37	43564	13840	3.1	0.3	[3OSO$_3$]Galβ1-4GlcNAcβ-Sp8
39	51862	41364	1.3	0.8	[4OSO$_3$][6OSO$_3$]Galβ1-4GlcNAcβ-Sp0
40	36536	35822	1.0	1.0	[4OSO$_3$]Galβ1-4GlcNAcβ-Sp8
43	11423	4663	2.4	0.4	[6OSO$_3$]Galβ1-4Glcβ–Sp8
44	39820	31693	1.3	0.8	[6OSO$_3$]Galβ1-4GlcNAcβ–Sp8
49	40831	14349	2.8	0.4	9NAcNeu5Acα2-6Galβ1-4GlcNAcβ-Sp8
56	19129	37506	0.5	2.0	Fucα1-2Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ-Sp9
58	20324	42373	0.5	2.1	Fucα1-2Galβ1-3GalNAcα–Sp8
61	4685	33695	0.1	7.2	Fucα1-2Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ–Sp10
62	2202	31541	0.1	14.3	Fucα1-2Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ–Sp8
63	5227	36363	0.1	7.0	Fucα1-2Galβ1-3GlcNAcβ–Sp0
64	2135	25840	0.1	12.1	Fucα1-2Galβ1-3GlcNAcβ–Sp8
69	49573	45162	1.1	0.9	Fucα1-2Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAc–Sp0
70	34366	39153	0.9	1.1	Fucα1-2Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
71	21320	15106	1.4	0.7	Fucα1-2Galβ1-4GlcNAcβ–Sp0
72	16404	32034	0.5	2.0	Fucα1-2Galβ1-4GlcNAcβ–Sp8
73	13047	38905	0.3	3.0	Fucα1-2Galβ1-4Glcβ–Sp0
74	14881	29007	0.5	1.9	Fucα1-2Galβ–Sp8
75	42639	4602	9.3	0.1	Fucα1-2GlcNAcβ-Sp8
76	20963	6268	3.3	0.3	Fucα1-3GlcNAcβ–Sp8
77	10266	300	34.2	0.0	Fucα1-4GlcNAcβ–Sp8
81	19966	49	410.2	0.0	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ-Sp0
89	12347	5187	2.4	0.4	GalNAcβ1-3(Fucα1-2)Galβ-Sp8
90	36529	46924	0.8	1.3	GalNAcβ1-3Galα1-4Galβ1-4GlcNAcβ-Sp0
91	11370	10678	1.1	0.9	GalNAcβ1-4(Fucα1-3)GlcNAcβ-Sp0
92	43172	50543	0.9	1.2	GalNAcβ1-4GlcNAcβ–Sp0
93	39141	41036	1.0	1.0	GalNAcβ1-4GlcNAcβ–Sp8
100	36048	40417	0.9	1.1	Galα1-3(Galα1-4)Galβ1-4GlcNAcβ-Sp8
104	12015	7493	1.6	0.6	Galα1-3Galβ1-3GlcNAcβ-Sp0
105	38703	34850	1.1	0.9	Galα1-3Galβ1-4GlcNAcβ–Sp8
108	12995	14766	0.9	1.1	Galα1-4(Fucα1-2)Galβ1-4GlcNAcβ-Sp8
109	38332	49810	0.8	1.3	Galα1-4Galβ1-4GlcNAcβ–Sp0
110	44995	47444	0.9	1.1	Galα1-4Galβ1-4GlcNAcβ–Sp8
111	30117	5599	5.4	0.2	Galα1-4Galβ1-4Glcβ–Sp0
112	32364	21913	1.5	0.7	Galα1-4GlcNAcβ–Sp8
131	38279	18441	2.1	0.5	Galβ1-3GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
133	13851	479	28.9	0.0	Galβ1-3GlcNAcβ–Sp0
146	52863	43695	1.2	0.8	Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-

Glycan #	avg. signal for anti-15	avg. signal for anti-16	ratio 15/16	ratio 16/15	Glycan structure
					4GlcNAcβ–Sp0
147	41311	35835	1.2	0.9	Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0
152	43628	36837	1.2	0.8	Galβ1-4GlcNAcβ–Sp0
153	41902	36797	1.1	0.9	Galβ1-4GlcNAcβ–Sp8
156	44321	50792	0.9	1.1	GlcNAcα1-3Galβ1-4GlcNAcβ-Sp8
157	30535	35102	0.9	1.1	GlcNAcα1-6Galβ1-4GlcNAcβ-Sp8
166	42398	42819	1.0	1.0	GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
170	38321	43664	0.9	1.1	GlcNAcβ1-4Galβ1-4GlcNAcβ-Sp8
176	37510	37767	1.0	1.0	GlcNAcβ1-6Galβ1-4GlcNAcβ-Sp8
186	23297	245	95.1	0.0	GlcAβ1-6Galβ-Sp8
187	29202	8504	3.4	0.3	KDNα2-3Galβ1-3GlcNAcβ–Sp0
188	39026	35212	1.1	0.9	KDNα2-3Galβ1-4GlcNAcβ–Sp0
209	48891	40459	1.2	0.8	Neu5Acα2-3(GalNAcβ1-4)Galβ1-4GlcNAcβ-Sp0
210	32641	39618	0.8	1.2	Neu5Acα2-3(GalNAcβ1-4)Galβ1-4GlcNAcβ-Sp8
215	39242	24125	1.6	0.6	Neu5Acα2-3GalNAcβ1-4GlcNAcβ-Sp0
224	38908	37516	1.0	1.0	NeuAcα2-3Galβ1-3GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
225	11031	831	13.3	0.1	Neu5Acα2-3Galβ1-3GlcNAcβ–Sp0
226	13761	5659	2.4	0.4	Neu5Acα2-3Galβ1-3GlcNAcβ–Sp8
227	53	25737	0.0	486.8	Neu5Acα2-3Galβ1-4[6OSO$_3$]GlcNAcβ-Sp8
233	38844	40776	1.0	1.0	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp8
235	44854	35554	1.3	0.8	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0
236	40562	21498	1.9	0.5	Neu5Acα2-3Galβ1-4GlcNAcβ–Sp0
237	39170	11658	3.4	0.3	Neu5Acα2-3Galβ1-4GlcNAcβ–Sp8
238	46364	40220	1.2	0.9	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
243	38080	31077	1.2	0.8	Neu5Acα2-6GalNAcβ1-4GlcNAcβ-Sp0
245	48770	46044	1.1	0.9	Neu5Acα2-6Galβ1-4GlcNAcβ–Sp0
246	32340	20876	1.5	0.6	Neu5Acα2-6Galβ1-4GlcNAcβ–Sp8
248	28721	27653	1.0	1.0	Neu5Acα2-6Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
255	43775	20093	2.2	0.5	Neu5Acβ2-6Galβ1-4GlcNAcβ-Sp8
258	22533	1147	19.6	0.1	Neu5Gcα2-3Galβ1-3GlcNAcβ-Sp0
260	37350	24770	1.5	0.7	Neu5Gcα2-3Galβ1-4GlcNAcβ–Sp0
263	39710	31291	1.3	0.8	Neu5Gcα2-6Galβ1-4GlcNAcβ–Sp0

Table S4. (data for Figure S7; comparison of CPMV and KLH platforms). Glycan array analysis (v2.0) for total IgY derived from immunization with **15** vs. **16**. These are the weak signals (average signal intensity <20% of maximum for both; values are derived from the independent experiments listed in Tables S1 and S2.

*Signal strength in the bottom 20% for both anti-**15** and anti-**16***

Glycan #	avg. signal for anti-15	avg. signal for anti-16	ratio 15/16	ratio 16/15	Glycan structure
1	96	35	2.7	0.4	AGP
2	32	26	1.2	0.8	AGP-A
3	32	42	0.8	1.3	AGP-B
4	107	42	2.6	0.4	Ceruloplasmine
5	34	53	0.6	1.6	Fibrinogen
6	1576	7190	0.2	4.6	Transferrin
7	5392	2115	2.5	0.4	α-D-Gal–Sp8
8	27	16	1.7	0.6	α-D-Glc–Sp8
9	62	59	1.0	1.0	a-D-Man–Sp8
10	32	31	1.0	1.0	α-GalNAc–Sp8
11	25	3091	0.0	126.2	α-L-Fuc–Sp8
12	10522	5250	2.0	0.5	α-L-Fuc–Sp9
14	34	598	0.1	17.8	α-Neu5Ac-Sp8
15	138	58	2.4	0.4	Neu5Acα1-2–Sp82
16	44	27	1.6	0.6	β-Neu5Ac-Sp8
17	51	22	2.3	0.4	β-D-Gal–Sp8
18	73	34	2.1	0.5	β-D-Glc–Sp8
19	25	60	0.4	2.4	β-D-Man–Sp8
20	3195	49	65.6	0.0	β-GalNAc–Sp8
23	144	8	17.6	0.1	β-GlcN(Gc)-Sp8
24	160	38	4.2	0.2	(Galβ1-4GlcNAcβ)$_2$-3,6-GalNAcα–Sp8
25	19	39	0.5	2.0	(GlcNAcβ1-3(GlcNAcβ1-6) GlcNAcβ1-4)GlcNAc-Sp8
28	35	24	1.5	0.7	[3OSO$_3$]Galβ1-4Glcβ-Sp8
29	110	31	3.6	0.3	[3OSO$_3$]Galβ1-4(6OSO$_3$)Glcβ–Sp0
30	4611	7700	0.6	1.7	[3OSO$_3$]Galβ1-4(6OSO$_3$)Glcβ–Sp8
32	4623	33	141.1	0.0	[3OSO$_3$]Galβ1-3GalNAcα–Sp8
34	180	3988	0.0	22.2	[3OSO$_3$]Galβ1-4(Fucα1-3)GlcNAcβ–Sp8
38	9287	7623	1.2	0.8	[3OSO$_3$]Galβ–Sp8
41	84	129	0.7	1.5	6-H$_2$PO$_3$Manα–Sp8
42	848	51	16.7	0.1	[6OSO$_3$]Galβ1-4Glcβ–Sp0
45	24	28	0.9	1.1	[6OSO$_3$]Galβ1-4[6OSO$_3$]Glcβ-Sp8
46	551	21	26.7	0.0	NeuAcα2-3[6OSO$_3$]Galβ1-4GlcNAcβ–Sp8
47	1483	27	55.1	0.0	[6OSO$_3$]GlcNAcβ–Sp8
48	10528	6326	1.7	0.6	9NAcNeu5Acα-Sp8
50	41	14	2.9	0.3	5-OS-G
51	29	22	1.3	0.8	7-OS-G
52	24	175	0.1	7.4	9-OS–G
53	40	19	2.1	0.5	11-OS-G
54	167	49	3.4	0.3	11-OS-Sp8
55	5200	9692	0.5	1.9	Fucα1-2Galβ1-3GalNAcβ1-3Galα-Sp9
57	4850	3705	1.3	0.8	Fucα1-2Galβ1-3(Fucα1-4)GlcNAcβ–Sp8
59	1378	448	3.1	0.3	Fucα1-2Galβ1-3GalNAcβ1-4(Neu5Acα2-3)Galβ1-4Glcβ-Sp0
60	5414	8519	0.6	1.6	Fucα1-2Galβ1-3GalNAcβ1-4(Neu5Acα2-3)Galβ1-4Glcβ-Sp9
65	310	11	27.5	0.0	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
66	543	34	15.7	0.1	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
67	18	34	0.5	1.9	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ–Sp0
68	5216	7695	0.7	1.5	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ–Sp8

*Signal strength in the bottom 20% for both anti-**15** and anti-**16***

Glycan #	avg. signal for anti-15	avg. signal for anti-16	ratio 15/16	ratio 16/15	Glycan structure
78	1415	933	1.5	0.7	Fucβ1-3GlcNAcβ-Sp8
79	29	26	1.1	0.9	GalNAcα1-3(Fucα1-2)Galβ1-3GlcNAcβ-Sp0
80	1886	24	79.7	0.0	GalNAcα1-3(Fucα1-2)Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
82	2548	41	61.8	0.0	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ–Sp8
83	34	29	1.2	0.9	GalNAcα1-3(Fucα1-2)Galβ1-4Glcβ-Sp0
84	21	26	0.8	1.2	GalNAcα1-3(Fucα1-2)Galβ–Sp8
85	43	6148	0.0	141.8	GalNAcA1-3GalNAcβ–Sp8
86	2168	597	3.6	0.3	GalNAcα1-3Galβ–Sp8
87	4315	1979	2.2	0.5	GalNAcα1-4(Fucα1-2)Galβ1-4GlcNAcβ-Sp8
88	466	319	1.5	0.7	GalNAcβ1-3GalNAcα–Sp8
94	249	210	1.2	0.8	Galα1-2Galβ–Sp8
95	28	37	0.8	1.3	Galα1-3(Fucα1-2)Galβ1-3GlcNAcβ-Sp0
96	543	93	5.8	0.2	Galα1-3(Fucα1-2)Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
97	2332	42	56.1	0.0	Galα1-3(Fucα1-2)Galβ1-4GlcNAc-Sp0
98	24	54	0.4	2.2	Galα1-3(Fucα1-2)Galβ1-4Glcβ-Sp0
99	7738	4946	1.6	0.6	Galα1-3(Fucα1-2)Galβ–Sp8
101	30	30	1.0	1.0	Galα1-3GalNAcα-Sp8
102	82	62	1.3	0.8	Galα1-3GalNAcβ–Sp8
103	252	80	3.1	0.3	Galα1-3Galβ1-4(Fucα1-3)GlcNAcβ–Sp8
106	109	251	0.4	2.3	Galα1-3Galβ1-4Glcβ–Sp0
107	2568	4249	0.6	1.7	Galα1-3Galβ–Sp8
113	1415	497	2.8	0.4	Galα1-6Glcβ-Sp8
114	281	35	7.9	0.1	Galβ1-2Galβ–Sp8
115	198	40	4.9	0.2	Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
116	581	14	41.7	0.0	Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
117	198	23	8.6	0.1	Galβ1-3(Fucα1-4)GlcNAc–Sp0
118	100	16	6.2	0.2	Galβ1-3(Fucα1-4)GlcNAc–Sp8
119	108	38	2.8	0.4	Galβ1-3(Fucα1-4)GlcNAcβ–Sp8
120	6379	6108	1.0	1.0	Galβ1-3(Galβ1-4GlcNAcβ1-6)GalNAcα-Sp8
121	32	26	1.2	0.8	Galβ1-3(GlcNAcβ1-6)GalNAcα-Sp8
122	20	36	0.5	1.8	Galβ1-3(Neu5Acα2-6)GalNAcα-Sp8
123	23	29	0.8	1.3	Galβ1-3(Neu5Acβ2-6)GalNAcα-Sp8
124	23	33	0.7	1.4	Galβ1-3(Neu5Acα2-6)GlcNAcβ1-4Galβ1-4Glcβ-Sp10
125	29	22	1.3	0.8	Galβ1-3GalNAcα-Sp8
126	192	1104	0.2	5.8	Galβ1-3GalNAcβ–Sp8
127	166	3198	0.1	19.2	Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ-Sp0
128	49	37	1.3	0.8	Galβ1-3GalNAcβ1-4(Neu5Acα2-3)Galβ1-4Glcβ-Sp0
129	20	717	0.0	35.5	Galβ1-3GalNAcβ1-4Galβ1-4Glcβ–Sp8
130	10431	6978	1.5	0.7	Galβ1-3Galβ–Sp8
132	2375	183	12.9	0.1	Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ–Sp10
134	2332	58	40.0	0.0	Galβ1-3GlcNAcβ–Sp8
135	123	39	3.2	0.3	Galβ1-4(Fucα1-3)GlcNAcβ–Sp0
136	106	19	5.5	0.2	Galβ1-4(Fucα1-3)GlcNAcβ–Sp8
137	862	34	25.6	0.0	Galβ1-4(Fucα1-3)GlcNAcβ1-4Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
138	1298	28	46.2	0.0	Galβ1-4(Fucα1-3)GlcNAcβ1-4Galβ1-4(Fucα1-3)GlcNAcβ1-4Galβ1-4(Fucα1-3)GlcNAcβ–Sp0
139	34	150	0.2	4.4	Galβ1-4[6OSO$_3$]Glcβ–Sp0
140	1127	70	16.1	0.1	Galβ1-4[6OSO$_3$]Glcβ–Sp8
141	3688	590	6.3	0.2	Galβ1-4GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ-Sp8
142	5641	2329	2.4	0.4	Galβ1-4GalNAcβ1-3(Fucα1-2)Galβ1-4GlcNAcβ-Sp8
143	26	15	1.7	0.6	Galβ1-4GlcNAcβ1-3(Galβ1-4GlcNAcβ1-6)GalNAcα-Sp8
144	80	41	2.0	0.5	Galβ1-4GlcNAcβ1-3GalNAcα–Sp8

*Signal strength in the bottom 20% for both anti-**15** and anti-**16***

Glycan #	avg. signal for anti-15	avg. signal for anti-16	ratio 15/16	ratio 16/15	Glycan structure
145	9278	9553	1.0	1.0	Galβ1-4GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
148	35	44	0.8	1.3	Galβ1-4GlcNAcβ1-3Galβ1-4Glcβ–Sp0
149	43	48	0.9	1.1	Galβ1-4GlcNAcβ1-3Galβ1-4Glcα–Sp8
150	18	21	0.9	1.1	Galβ1-4GlcNAcβ1-6(Galβ1-3)GalNAcα–Sp8
151	3620	55	65.2	0.0	Galβ1-4GlcNAcβ1-6GalNAcα–Sp8
154	23	120	0.2	5.1	Galβ1-4Glcβ–Sp0
155	6373	4409	1.4	0.7	Galβ1-4Glcβ–Sp8
158	44	14	3.1	0.3	GlcNAcβ1-2Galβ1-3GalNAcα–Sp8
159	28	29	1.0	1.1	GlcNAcβ1-3(GlcNAcβ1-6)GalNAcα–Sp8
160	27	19	1.4	0.7	GlcNAcβ1-3(GlcNAcβ1-6)Galβ1-4GlcNAcβ–Sp8
161	24	65	0.4	2.7	GlcNAcβ1-3GalNAcα–Sp8
162	25	29	0.8	1.2	GlcNAcβ1-3Galβ-Sp8
163	14	36	0.4	2.5	GlcNAcβ1-3Galβ1-3GalNAcα-Sp8
164	36	23	1.6	0.6	GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0
165	10646	7390	1.4	0.7	GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp8
167	1680	63	26.9	0.0	GlcNAcβ1-3Galβ1-4Glcβ–Sp0
168	4357	88	49.4	0.0	GlcNAcβ1-4MDPLys
169	9797	5438	1.8	0.6	GlcNAcβ1-4(GlcNAcβ1-6)GalNAcα-Sp8
171	15	36	0.4	2.4	$(GlcNAc\beta 1\text{-}4)_6\beta$-Sp8
172	15	13	1.2	0.9	$(GlcNAc\beta 1\text{-}4)_5\beta$-Sp8
173	21	11	1.9	0.5	GlcNAcβ1-4GlcNAcβ1-4GlcNAcβ–Sp8
174	43	21	2.1	0.5	GlcNAcβ1-6(Galβ1-3)GalNAcα–Sp8
175	7619	7633	1.0	1.0	GlcNAcβ1-6GalNAcα–Sp8
177	44	20	2.2	0.5	Glcα1-4Glcβ–Sp8
178	529	76	6.9	0.1	Glcα1-4Glcα–Sp8
179	88	159	0.6	1.8	Glcα1-6Glcα1-6Glcβ-Sp8
180	282	43	6.6	0.2	Glcβ1-4Glcβ-Sp8
181	311	51	6.1	0.2	Glcβ1-6Glcβ-Sp8
182	30	39	0.8	1.3	G-ol-amine
183	26	21	1.3	0.8	GlcA α-Sp8
184	58	12	4.7	0.2	GlcA β-Sp8
185	5990	39	154.9	0.0	GlcA β1-3Galβ-Sp8
189	27	24	1.1	0.9	Manα1-2Manα1-2Manα1-3Manα-Sp9
190	40	23	1.7	0.6	Manα1-2Manα1-3(Manα1-2Manα1-6)Manα-Sp9
191	12	24	0.5	2.0	Manα1-2Manα1-3Manα-Sp9
192	22	34	0.6	1.6	Manα1-6(Manα1-2Manα1-3)Manα1-6(Mana2Mana1-3)Manβ1-4GlcNAcβ1-4GlcNAcβ-N
193	5	46	0.1	8.7	Manα1-2Manα1-6(Manα1-3)Manα1-6(Manα2Manα2Manα1-3)Manβ1-4GlcNAcβ1-4GlcNAcβ-N
194	20	33	0.6	1.7	Manα1-2Manα1-2Manα1-3(Manα1-2Manα1-3(Manα1-2Manα1-6)Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ-N
195	26	12	2.2	0.4	Manα1-3(Manα1-6)Manα–Sp9
196	782	29	27.4	0.0	Manα1-3(Manα1-2Manα1-2Manα1-6)Manα-Sp9
197	6	40	0.1	6.7	Manα1-6(Manα1-3)Manα1-6(Manα2Manα1-3)Manβ1-4GlcNAcβ1-4GlcNAcβ-N
198	67	50	1.3	0.7	Manα1-6(Manα1-3)Manα1-6(Manα1-3)Manβ1-4GlcNAcβ1-4 GlcNAcβ-N
199	280	131	2.1	0.5	Man5_9mix N
200	23	31	0.7	1.4	Manβ1-4GlcNAcβ-Sp0
201	42	24	1.7	0.6	Neu5Acα2-3(Galβ1-3GalNAcβ1-4)Galβ1-4Glcβ-Sp0
202	24	33	0.7	1.4	Neu5Acα2-3Galβ1-3GalNAcα-Sp8
203	23	31	0.7	1.4	NeuAcα2-8NeuAcα2-8NeuAcα2-8NeuAcα2-3(GalNAcβ1-4)Galβ1-4Glcβ-Sp0

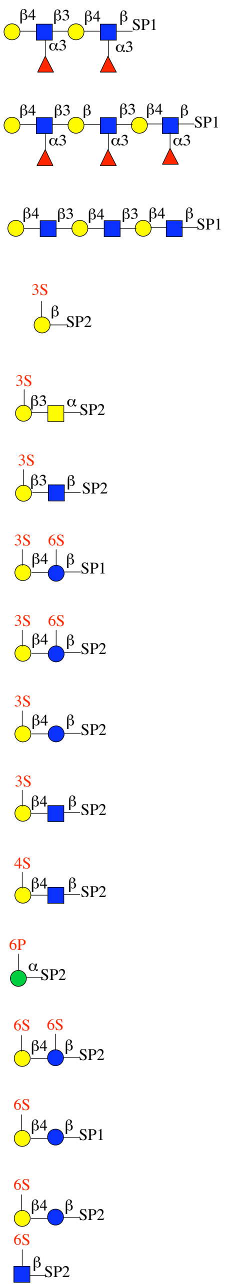
*Signal strength in the bottom 20% for both anti-**15** and anti-**16***

Glycan #	avg. signal for anti-15	avg. signal for anti-16	ratio 15/16	ratio 16/15	Glycan structure
204	112	13	8.8	0.1	Neu5Acα2-8Neu5Acα2-8Neu5Acα2-3(GalNAcβ1-4)Galβ1-4Glcβ-Sp0
205	26	39	0.7	1.5	Neu5Acα2-8Neu5Acα2-8Neu5Acα2-3Galβ1-4Glcβ–Sp0
206	39	42	0.9	1.1	Neu5Acα2-8Neu5Acα2-3(GalNAcβ1-4)Galβ1-4Glcβ–Sp0
207	74	35	2.1	0.5	Neu5Acα2-8Neu5Acα2-8Neu5Acα-Sp8
208	5790	3551	1.6	0.6	Neu5Acα2-3(6-O-Su)Galβ1-4(Fucα1-3)GlcNAcβ–Sp8
211	14	40	0.4	2.8	Neu5Acα2-3(GalNAcβ1-4)Galβ1-4Glcβ–Sp0
212	20	24	0.9	1.2	NeuAcα2-3(NeuAcα2-3Galβ1-3GalNAcβ1-4)Galβ1-4Glcβ-Sp0
213	69	265	0.3	3.9	Neu5Acα2-3(Neu5Acα2-6)GalNAcα–Sp8
214	5361	4376	1.2	0.8	Neu5Acα2-3GalNAcα–Sp8
216	43	30	1.5	0.7	Neu5Acα2-3Galβ1-3(6OSO$_3$)GlcNAc-Sp8
217	87	13	6.5	0.2	Neu5Acα2-3Galβ1-3(Fucα1-4)GlcNAcβ–Sp8
218	6194	7819	0.8	1.3	NeuAcα2-3Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ Sp0
219	205	32	6.4	0.2	Neu5Acα2-3Galβ1-3(Neu5Aα2-3Galβ1-4)GlcNAcβ-Sp8
220	49	16	3.1	0.3	Neu5Acα2-3Galβ1-3[6OSO$_3$]GalNAcα-Sp8
221	16	27	0.6	1.6	Neu5Acα2-3Galβ1-3(Neu5Aα2-6)GalNAcA–Sp8
222	41	132	0.3	3.2	Neu5Acα2-3Galβ-Sp8
223	5431	5518	1.0	1.0	NeuAcα2-3Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ-Sp0
228	165	29	5.7	0.2	Neu5Acα2-3Galβ1-4(Fucα1-3)(6OSO$_3$)GlcNAcβ–Sp8
229	2075	387	5.4	0.2	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ–Sp0
230	2397	1181	2.0	0.5	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ–Sp0
231	60	24	2.5	0.4	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ–Sp8
232	10654	4626	2.3	0.4	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ-Sp8
234	32	28	1.1	0.9	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAc-Sp0
239	35	15	2.3	0.4	Neu5Acα2-3Galβ1-4Glcβ–Sp0
240	45	42	1.1	0.9	Neu5Acα2-3Galβ1-4Glcβ–Sp8
241	39	23	1.7	0.6	Neu5Acα2-6(Galβ1-3)GalNAcα–Sp8
242	7561	7714	1.0	1.0	Neu5Acα2-6GalNAcα–Sp8
244	9250	4527	2.0	0.5	Neu5Acα2-6Galβ1-4[6OSO$_3$]GlcNAcβ-Sp8
247	951	50	18.9	0.1	Neu5Acα2-6Galβ1-4GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
249	27	22	1.2	0.8	Neu5Acα2-6Galβ1-4Glcβ–Sp0
250	61	66	0.9	1.1	Neu5Acα2-6Galβ1-4Glcβ–Sp8
251	51	24	2.1	0.5	Neu5Acα2-6Galβ–Sp8
252	28	26	1.1	0.9	Neu5Acα2-8Neu5Acα-Sp8
253	28	28	1.0	1.0	Neu5Acα2-8Neu5Acα2-3Galβ1-4Glcβ–Sp0
254	8228	7061	1.2	0.9	Neu5Acβ1-6GalNAcα–Sp8
256	621	34	18.2	0.1	Neu5Acβ2-6(Galβ1-3)GalNAcα–Sp8
257	5559	365	15.2	0.1	Neu5Gcα2-3Galβ1-3(Fucα1-4)GlcNAcβ-Sp0
259	7974	6958	1.1	0.9	Neu5Gcα2-3Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
261	36	42	0.9	1.2	Neu5Gcα2-3Galβ1-4Glcβ–Sp0
262	10685	10460	1.0	1.0	Neu5Gcα2-6GalNAcα–Sp0
264	2523	17	147.9	0.0	Neu5Gcα–Sp8

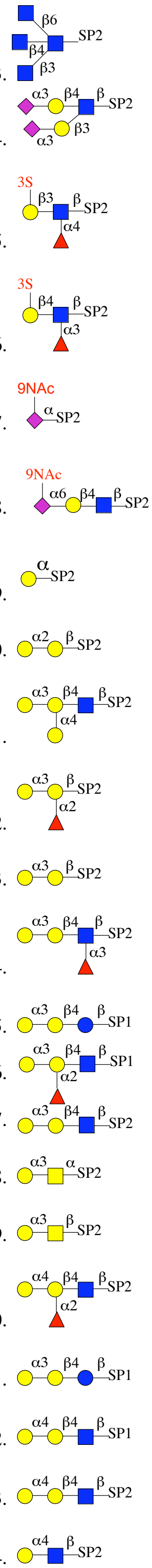
Table S7. Glycans array v1.0.

1. α_1–AGP
2. α_1–AGPA
3. α_1–AGPB
4. Ceruloplasmine
5. Fibrinogen
6. Transferrin

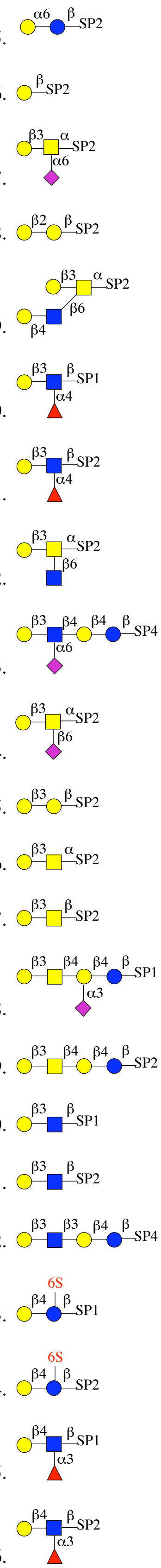
7.–22.

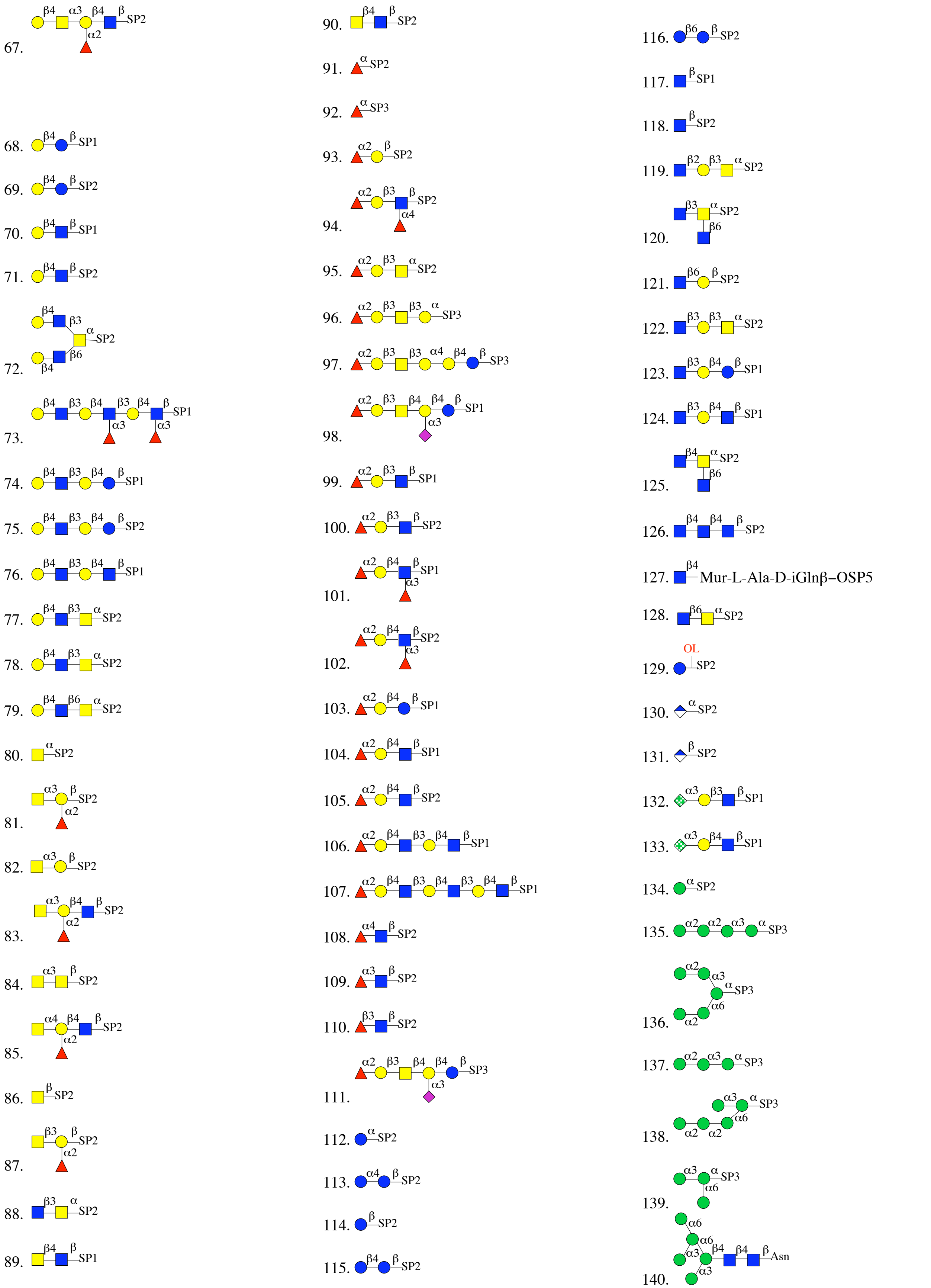


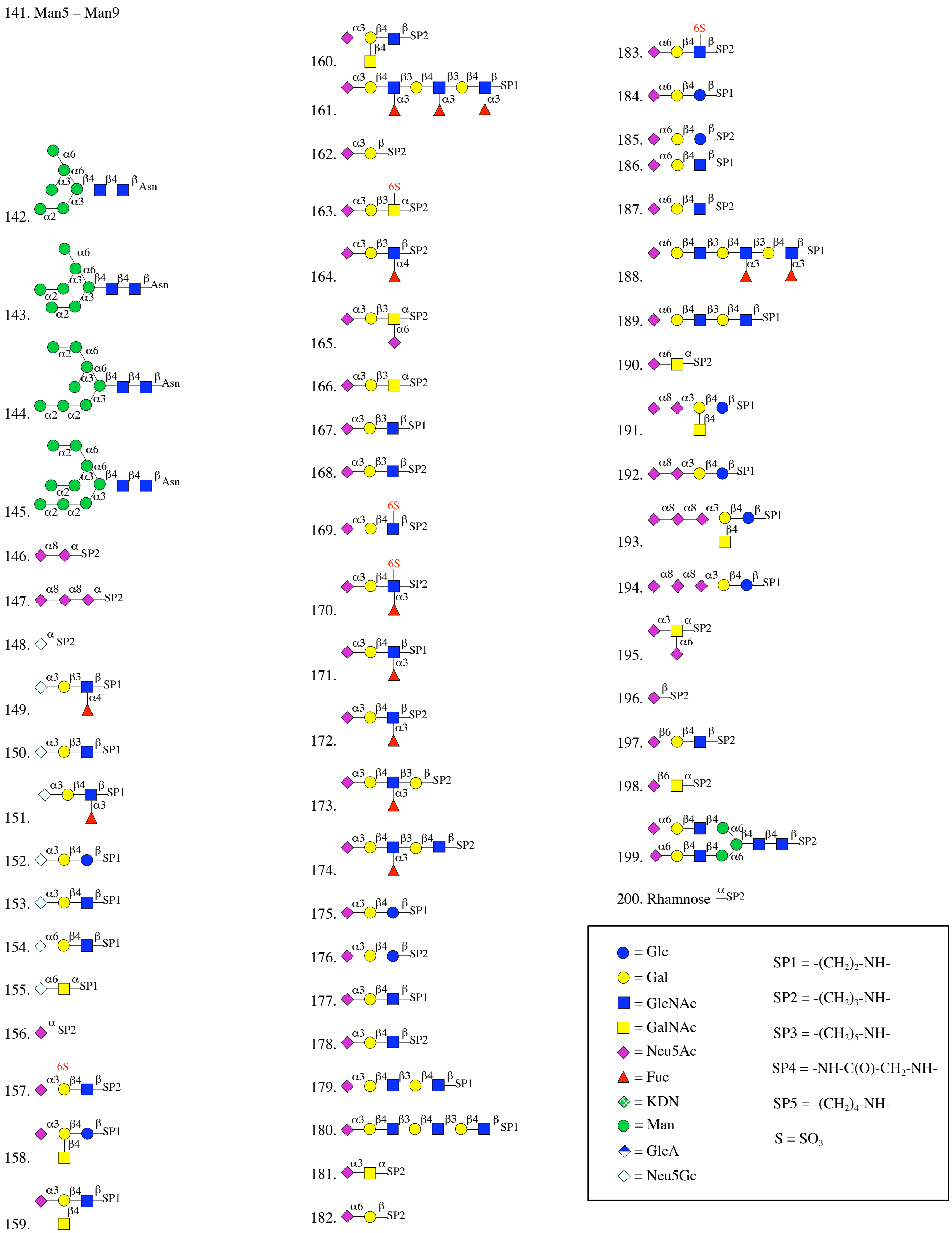
23.–44.



45.–66.




67. SP2
68. SP1
69. SP2
70. SP1
71. SP2
72. SP2
73. SP1
74. SP1
75. SP2
76. SP1
77. SP2
78. SP2
79. SP2
80. SP2
81. SP2
82. SP2
83. SP2
84. SP2
85. SP2
86. SP2
87. SP2
88. SP2
89. SP1
90. SP2
91. SP2
92. SP3
93. SP2
94. SP2
95. SP2
96. SP3
97. SP3
98. SP1
99. SP1
100. SP2
101. SP1
102. SP2
103. SP1
104. SP1
105. SP2
106. SP1
107. SP1
108. SP2
109. SP2
110. SP2
111. SP3
112. SP2
113. SP2
114. SP2
115. SP2
116. SP2
117. SP1
118. SP2
119. SP2
120. SP2
121. SP2
122. SP2
123. SP1
124. SP1
125. SP2
126. SP2
127. Mur-L-Ala-D-iGlnβ–OSP5
128. SP2
129. OL SP2
130. SP2
131. SP2
132. SP1
133. SP1
134. SP2
135. SP3
136. SP3
137. SP3
138. SP3
139. SP3
140. Asn


141. Man5 – Man9
142.
143.
144.
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192.
193.
194.
195.
196.
197.
198.
199.
200. Rhamnose
= Glc
= Gal
= GlcNAc
= GalNAc
= Neu5Ac
= Fuc
= KDN
= Man
= GlcA
= Neu5Gc
SP1 = -(CH2)2-NH-
SP2 = -(CH2)3-NH-
SP3 = -(CH2)5-NH-
SP4 = -NH-C(O)-CH2-NH-
SP5 = -(CH2)4-NH-
S = SO3

Table S8 . Glycan array v2.0.

#	Glycan structure
1	AGP
2	AGP-A
3	AGP-B
4	Ceruloplasmine
5	Fibrinogen
6	Transferrin
7	α-D-Gal–Sp8
8	α-D-Glc–Sp8
9	a-D-Man–Sp8
10	α-GalNAc–Sp8
11	α-L-Fuc–Sp8
12	α-L-Fuc–Sp9
13	α-L-Rhα–Sp8
14	α-Neu5Ac-Sp8
15	Neu5Acα1-2–Sp82
16	β-Neu5Ac-Sp8
17	β-D-Gal–Sp8
18	β-D-Glc–Sp8
19	β-D-Man–Sp8
20	β-GalNAc–Sp8
21	β-GlcNAc–Sp0
22	β-GlcNAc–Sp8
23	β-GlcN(Gc)-Sp8
24	(Galβ1-4GlcNAcβ)$_2$-3,6-GalNAcα–Sp8
25	(GlcNAcβ1-3(GlcNAcβ1-6) GlcNAcβ1-4)GlcNAc-Sp8
26	[3OSO$_3$][6OSO$_3$]Galβ1-4[6OSO$_3$]GlcNAcβ-Sp0
27	[3OSO$_3$][6OSO$_3$]Galβ1-4GlcNAcβ-Sp0
28	[3OSO$_3$]Galβ1-4Glcβ-Sp8
29	[3OSO$_3$]Galβ1-4(6OSO$_3$)Glcβ–Sp0
30	[3OSO$_3$]Galβ1-4(6OSO$_3$)Glcβ–Sp8
31	[3OSO$_3$]Galβ1-3(Fucα1-4)GlcNAcβ–Sp8
32	[3OSO$_3$]Galβ1-3GalNAcα–Sp8
33	[3OSO$_3$]Galβ1-3GlcNAcβ–Sp8
34	[3OSO$_3$]Galβ1-4(Fucα1-3)GlcNAcβ–Sp8
35	[3OSO$_3$]Galβ1-4[6OSO$_3$]GlcNAcβ-Sp8
36	[3OSO$_3$]Galβ1-4GlcNAcβ–Sp0
37	[3OSO$_3$]Galβ1-4GlcNAcβ-Sp8
38	[3OSO$_3$]Galβ–Sp8
39	[4OSO$_3$][6OSO$_3$]Galβ1-4GlcNAcβ-Sp0
40	[4OSO$_3$]Galβ1-4GlcNAcβ-Sp8
41	6-H$_2$PO$_3$Manα–Sp8
42	[6OSO$_3$]Galβ1-4Glcβ–Sp0
43	[6OSO$_3$]Galβ1-4Glcβ–Sp8
44	[6OSO$_3$]Galβ1-4GlcNAcβ–Sp8
45	[6OSO$_3$]Galβ1-4[6OSO$_3$]Glcβ-Sp8
46	NeuAcα2-3[6OSO$_3$]Galβ1-4GlcNAcβ–Sp8
47	[6OSO$_3$]GlcNAcβ–Sp8
48	9NAcNeu5Acα-Sp8
49	9NAcNeu5Acα2-6Galβ1-4GlcNAcβ-Sp8
50	5-OS-G
51	7-OS-G
52	9-OS–G
53	11-OS-G
54	11-OS-Sp8
55	Fucα1-2Galβ1-3GalNAcβ1-3Galα-Sp9
56	Fucα1-2Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ-Sp9
57	Fucα1-2Galβ1-3(Fucα1-4)GlcNAcβ–Sp8
58	Fucα1-2Galβ1-3GalNAcα–Sp8
59	Fucα1-2Galβ1-3GalNAcβ1-4(Neu5Acα2-3)Galβ1-4Glcβ-Sp0
60	Fucα1-2Galβ1-3GalNAcβ1-4(Neu5Acα2-3)Galβ1-4Glcβ-Sp9
61	Fucα1-2Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ–Sp10
62	Fucα1-2Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ–Sp8
63	Fucα1-2Galβ1-3GlcNAcβ–Sp0
64	Fucα1-2Galβ1-3GlcNAcβ–Sp8
65	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
66	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Gaβ1-4(Fucα1-3)GlcNAcβ-Sp0
67	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ–Sp0
68	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ–Sp8
69	Fucα1-2Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAc–Sp0
70	Fucα1-2Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
71	Fucα1-2Galβ1-4GlcNAcβ–Sp0
72	Fucα1-2Galβ1-4GlcNAcβ–Sp8
73	Fucα1-2Galβ1-4Glcβ–Sp0
74	Fucα1-2Galβ–Sp8
75	Fucα1-2GlcNAcβ-Sp8

76 Fucα1-3GlcNAcβ–Sp8
77 Fucα1-4GlcNAcβ–Sp8
78 Fucβ1-3GlcNAcβ-Sp8
79 GalNAcα1-3(Fucα1-2)Galβ1-3GlcNAcβ-Sp0
80 GalNAcα1-3(Fucα1-2)Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
81 GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ-Sp0
82 GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ–Sp8
83 GalNAcα1-3(Fucα1-2)Galβ1-4Glcβ-Sp0
84 GalNAcα1-3(Fucα1-2)Galβ–Sp8
85 GalNAcA1-3GalNAcβ–Sp8
86 GalNAcα1-3Galβ–Sp8
87 GalNAcα1-4(Fucα1-2)Galβ1-4GlcNAcβ-Sp8
88 GalNAcβ1-3GalNAcα–Sp8
89 GalNAcβ1-3(Fucα1-2)Galβ-Sp8
90 GalNAcβ1-3Galα1-4Galβ1-4GlcNAcβ-Sp0
91 GalNAcβ1-4(Fucα1-3)GlcNAcβ-Sp0
92 GalNAcβ1-4GlcNAcβ–Sp0
93 GalNAcβ1-4GlcNAcβ–Sp8
94 Galα1-2Galβ–Sp8
95 Galα1-3(Fucα1-2)Galβ1-3GlcNAcβ-Sp0
96 Galα1-3(Fucα1-2)Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
97 Galα1-3(Fucα1-2)Galβ1-4GlcNAc-Sp0
98 Galα1-3(Fucα1-2)Galβ1-4Glcβ-Sp0
99 Galα1-3(Fucα1-2)Galβ–Sp8
100 Galα1-3(Galα1-4)Galβ1-4GlcNAcβ-Sp8
101 Galα1-3GalNAcα-Sp8
102 Galα1-3GalNAcβ–Sp8
103 Galα1-3Galβ1-4(Fucα1-3)GlcNAcβ–Sp8
104 Galα1-3Galβ1-3GlcNAcβ-Sp0
105 Galα1-3Galβ1-4GlcNAcβ–Sp8
106 Galα1-3Galβ1-4Glcβ–Sp0
107 Galα1-3Galβ–Sp8
108 Galα1-4(Fucα1-2)Galβ1-4GlcNAcβ-Sp8
109 Galα1-4Galβ1-4GlcNAcβ–Sp0
110 Galα1-4Galβ1-4GlcNAcβ–Sp8
111 Galα1-4Galβ1-4Glcβ–Sp0
112 Galα1-4GlcNAcβ–Sp8
113 Galα1-6Glcβ-Sp8
114 Galβ1-2Galβ–Sp8
115 Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
116 Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
117 Galβ1-3(Fucα1-4)GlcNAc–Sp0
118 Galβ1-3(Fucα1-4)GlcNAc–Sp8
119 Galβ1-3(Fucα1-4)GlcNAcβ–Sp8
120 Galβ1-3(Galβ1-4GlcNAcβ1-6)GalNAcα-Sp8
121 Galβ1-3(GlcNAcβ1-6)GalNAcα-Sp8
122 Galβ1-3(Neu5Acα2-6)GalNAcα-Sp8
123 Galβ1-3(Neu5Acβ2-6)GalNAcα-Sp8
124 Galβ1-3(Neu5Acα2-6)GlcNAcβ1-4Galβ1-4Glcβ-Sp10
125 Galβ1-3GalNAcα-Sp8
126 Galβ1-3GalNAcβ–Sp8
127 Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ-Sp0
128 Galβ1-3GalNAcβ1-4(Neu5Acα2-3)Galβ1-4Glcβ-Sp0
129 Galβ1-3GalNAcβ1-4Galβ1-4Glcβ–Sp8
130 Galβ1-3Galβ–Sp8
131 Galβ1-3GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
132 Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ–Sp10
133 Galβ1-3GlcNAcβ–Sp0
134 Galβ1-3GlcNAcβ–Sp8
135 Galβ1-4(Fucα1-3)GlcNAcβ–Sp0
136 Galβ1-4(Fucα1-3)GlcNAcβ–Sp8
137 Galβ1-4(Fucα1-3)GlcNAcβ1-4Galβ1-4(Fucα1-3)GlcNAcβ-Sp0
138 Galβ1-4(Fucα1-3)GlcNAcβ1-4Galβ1-4(Fucα1-3)GlcNAcβ1-4Galβ1-4(Fucα1-3)GlcNAcβ–Sp0
139 Galβ1-4[$6OSO_3$]Glcβ–Sp0
140 Galβ1-4[$6OSO_3$]Glcβ–Sp8
141 Galβ1-4GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ-Sp8
142 Galβ1-4GalNAcβ1-3(Fucα1-2)Galβ1-4GlcNAcβ-Sp8
143 Galβ1-4GlcNAcβ1-3(Galβ1-4GlcNAcβ1-6)GalNAcα-Sp8
144 Galβ1-4GlcNAcβ1-3GalNAcα–Sp8
145 Galβ1-4GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ-Sp0

146 Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0
147 Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0
148 Galβ1-4GlcNAcβ1-3Galβ1-4Glcβ–Sp0
149 Galβ1-4GlcNAcβ1-3Galβ1-4Glcα–Sp8
150 Galβ1-4GlcNAcβ1-6(Galβ1-3)GalNAcα–Sp8
151 Galβ1-4GlcNAcβ1-6GalNAcα–Sp8
152 Galβ1-4GlcNAcβ–Sp0
153 Galβ1-4GlcNAcβ–Sp8
154 Galβ1-4Glcβ–Sp0
155 Galβ1-4Glcβ–Sp8
156 GlcNAcα1-3Galβ1-4GlcNAcβ-Sp8
157 GlcNAcα1-6Galβ1-4GlcNAcβ-Sp8
158 GlcNAcβ1-2Galβ1-3GalNAcα–Sp8
159 GlcNAcβ1-3(GlcNAcβ1-6)GalNAcα–Sp8
160 GlcNAcβ1-3(GlcNAcβ1-6)Galβ1-4GlcNAcβ–Sp8
161 GlcNAcβ1-3GalNAcα–Sp8
162 GlcNAcβ1-3Galβ-Sp8
163 GlcNAcβ1-3Galβ1-3GalNAcα-Sp8
164 GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0
165 GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp8
166 GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0
167 GlcNAcβ1-3Galβ1-4Glcβ–Sp0
168 GlcNAcβ1-4MDPLys
169 GlcNAcβ1-4(GlcNAcβ1-6)GalNAcα-Sp8
170 GlcNAcβ1-4Galβ1-4GlcNAcβ-Sp8

171 (GlcNAcβ1-4)$_6$β-Sp8
172 (GlcNAcβ1-4)$_5$β-Sp8
173 GlcNAcβ1-4GlcNAcβ1-4GlcNAcβ–Sp8
174 GlcNAcβ1-6(Galβ1-3)GalNAcα–Sp8
175 GlcNAcβ1-6GalNAcα–Sp8
176 GlcNAcβ1-6Galβ1-4GlcNAcβ-Sp8
177 Glcα1-4Glcβ–Sp8
178 Glcα1-4Glcα–Sp8
179 Glcα1-6Glcα1-6Glcβ-Sp8
180 Glcβ1-4Glcβ-Sp8
181 Glcβ1-6Glcβ-Sp8
182 G-ol-amine
183 GlcAα-Sp8
184 GlcAβ-Sp8
185 GlcAβ1-3Galβ-Sp8
186 GlcAβ1-6Galβ-Sp8
187 KDNα2-3Galβ1-3GlcNAcβ–Sp0
188 KDNα2-3Galβ1-4GlcNAcβ–Sp0
189 Manα1-2Manα1-2Manα1-3Manα-Sp9
190 Manα1-2Manα1-3(Manα1-2Manα1-6)Manα-Sp9
191 Manα1-2Manα1-3Manα-Sp9
192 Manα1-6(Manα1-2Manα1-3)Manα1-6(Mana2Mana1-3)Manβ1-4GlcNAcβ1-4GlcNAcβ-N
193 Manα1-2Manα1-6(Manα1-3)Manα1-6(Manα2Manα2Manα1-3)Manβ1-4GlcNAcβ1-4GlcNAcβ-N
194 Manα1-2Manα1-2Manα1-3(Manα1-2Manα1-3(Manα1-2Manα1-6)Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ-N

195 Manα1-3(Manα1-6)Manα–Sp9
196 Manα1-3(Manα1-2Manα1-2Manα1-6)Manα-Sp9
197 Manα1-6(Manα1-3)Manα1-6(Manα2Manα1-3)Manβ1-4GlcNAcβ1-4GlcNAcβ-N
198 Manα1-6(Manα1-3)Manα1-6(Manα1-3)Manβ1-4GlcNAcβ1-4 GlcNAcβ-N
199 Man5_9mix N
200 Manβ1-4GlcNAcβ-Sp0
201 Neu5Acα2-3(Galβ1-3GalNAcβ1-4)Galβ1-4Glcβ-Sp0
202 Neu5Acα2-3Galβ1-3GalNAcα-Sp8
203 NeuAcα2-8NeuAcα2-8NeuAcα2-8NeuAcα2-3(GalNAcβ1-4)Galβ1-4Glcβ-Sp0
204 Neu5Acα2-8Neu5Acα2-8Neu5Acα2-3(GalNAcβ1-4)Galβ1-4Glcβ-Sp0
205 Neu5Acα2-8Neu5Acα2-8Neu5Acα2-3Galβ1-4Glcβ–Sp0
206 Neu5Acα2-8Neu5Acα2-3(GalNAcβ1-4)Galβ1-4Glcβ–Sp0
207 Neu5Acα2-8Neu5Acα2-8Neu5Acα-Sp8
208 Neu5Acα2-3(6-O-Su)Galβ1-4(Fucα1-3)GlcNAcβ–Sp8
209 Neu5Acα2-3(GalNAcβ1-4)Galβ1-4GlcNAcβ-Sp0
210 Neu5Acα2-3(GalNAcβ1-4)Galβ1-4GlcNAcβ-Sp8
211 Neu5Acα2-3(GalNAcβ1-4)Galβ1-4Glcβ–Sp0

212 NeuAcα2-3(NeuAcα2-3Galβ1-3GalNAcβ1-4)Galβ1-4Glc β-Sp0

213 Neu5Acα2-3(Neu5Acα2-6)GalNAcα–Sp8

214 Neu5Acα2-3GalNAcα–Sp8

215 Neu5Acα2-3GalNAcβ1-4GlcNAcβ-Sp0

216 Neu5Acα2-3Galβ1-3(6OSO_3)GlcNAc-Sp8

217 Neu5Acα2-3Galβ1-3(Fucα1-4)GlcNAcβ–Sp8

218 NeuAcα2-3Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ Sp0

219 Neu5Acα2-3Galβ1-3(Neu5Acα2-3Galβ1-4)GlcNAcβ-Sp8

220 Neu5Acα2-3Galβ1-3[6OSO_3]GalNAcα-Sp8

221 Neu5Acα2-3Galβ1-3(Neu5Acα2-6)GalNAcA–Sp8

222 Neu5Acα2-3Galβ-Sp8

223 NeuAcα2-3Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ-Sp0

224 NeuAcα2-3Galβ1-3GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0

225 Neu5Acα2-3Galβ1-3GlcNAcβ–Sp0

226 Neu5Acα2-3Galβ1-3GlcNAcβ–Sp8

227 Neu5Acα2-3Galβ1-4[6OSO_3]GlcNAcβ-Sp8

228 Neu5Acα2-3Galβ1-4(Fucα1-3)(6OSO_3)GlcNAcβ–Sp8

229 Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ–Sp0

230 Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ–Sp0

231 Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ–Sp8

232 Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ-Sp8

233 Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp8

234 Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAc-Sp0

235 Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ–Sp0

236 Neu5Acα2-3Galβ1-4GlcNAcβ–Sp0

237 Neu5Acα2-3Galβ1-4GlcNAcβ–Sp8

238 Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0

239 Neu5Acα2-3Galβ1-4Glcβ–Sp0

240 Neu5Acα2-3Galβ1-4Glcβ–Sp8

241 Neu5Acα2-6(Galβ1-3)GalNAcα–Sp8

242 Neu5Acα2-6GalNAcα–Sp8

243 Neu5Acα2-6GalNAcβ1-4GlcNAcβ-Sp0

244 Neu5Acα2-6Galβ1-4[6OSO_3]GlcNAcβ-Sp8

245 Neu5Acα2-6Galβ1-4GlcNAcβ–Sp0

246 Neu5Acα2-6Galβ1-4GlcNAcβ–Sp8

247 Neu5Acα2-6Galβ1-4GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ-Sp0

248 Neu5Acα2-6Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ-Sp0

249 Neu5Acα2-6Galβ1-4Glcβ–Sp0

250 Neu5Acα2-6Galβ1-4Glcβ–Sp8

251 Neu5Acα2-6Galβ–Sp8

252 Neu5Acα2-8Neu5Acα-Sp8

253 Neu5Acα2-8Neu5Acα2-3Galβ1-4Glcβ–Sp0

254 Neu5Acβ1-6GalNAcα–Sp8

255 Neu5Acβ2-6Galβ1-4GlcNAcβ-Sp8

256 Neu5Acβ2-6(Galβ1-3)GalNAcα–Sp8

257 Neu5Gcα2-3Galβ1-3(Fucα1-4)GlcNAcβ-Sp0

258 Neu5Gcα2-3Galβ1-3GlcNAcβ-Sp0

259 Neu5Gcα2-3Galβ1-4(Fucα1-3)GlcNAcβ-Sp0

260 Neu5Gcα2-3Galβ1-4GlcNAcβ–Sp0

261 Neu5Gcα2-3Galβ1-4Glcβ–Sp0

262 Neu5Gcα2-6GalNAcα–Sp0

263 Neu5Gcα2-6Galβ1-4GlcNAcβ–Sp0

264 Neu5Gcα–Sp8

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