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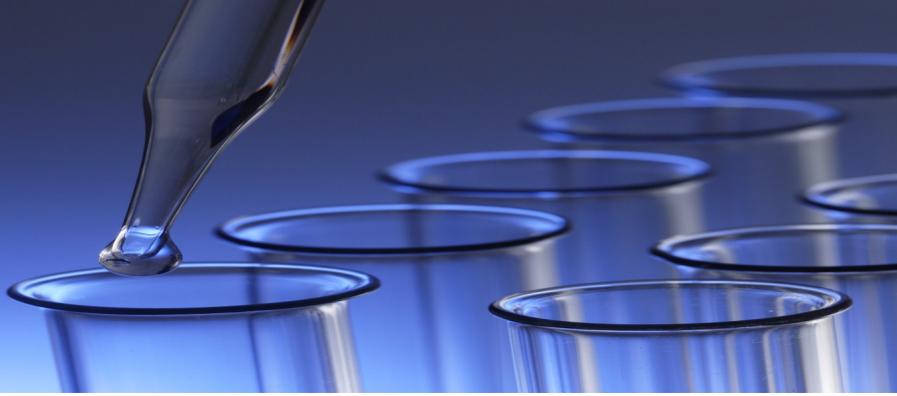


BLOOD GROUP PRODUCTS



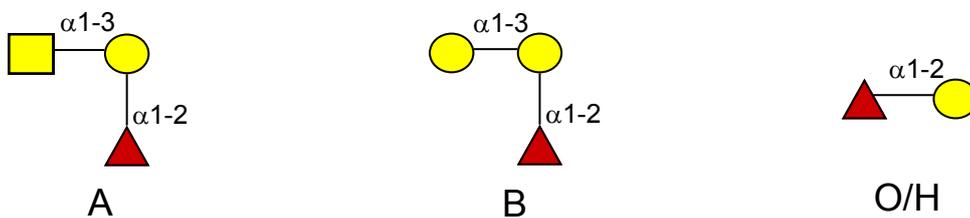
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The discovery of the ABO blood typing system by Karl Landsteiner over 100 years ago and the subsequent elucidation of their carbohydrate structures by Walter Morgan were exceedingly important milestones in the progression of modern medicine. The ABO system is the most important of the many blood typing systems and is of the utmost importance in transfusion and transplantation medicine. If patients receive a transfusion of incompatible blood, an acute haemolytic reaction can occur, this can lead to death.

The blood group antigens are oligosaccharides expressed on the surface of red blood cells and are determined by the terminal saccharides. The biosynthesis is effected via the action of the A or B glycosyltransferase on the H antigen, to form the A or B glycan. The H antigen remains unmodified in individuals lacking either of these glycosyltransferases, resulting in an individual with blood type O. The expression of these antigens is not limited to red blood cells and also occurs on epithelial and other cells.



Blood groups are determined by the ABO gene, which encodes the glycosyltransferase which forms the A, B and H antigens. The alleles for the A and B blood types show co-dominance, whilst the blood group O allele is recessive, giving rise to the familiar 4 ABO blood types.



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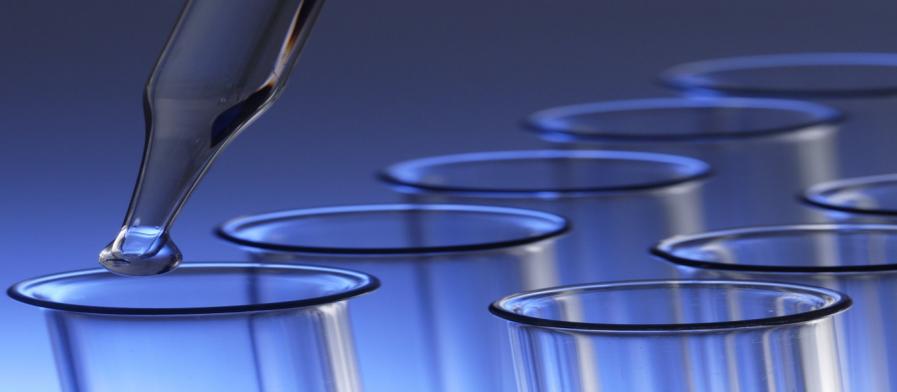
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At Dextra, we have proven expertise in the manufacture of a wide variety of blood group products, from the standard blood group oligosaccharides, to those functionalised with a selection of linker arms. To complement our free sugar range we also have the capability to produce these antigens as bioconjugates to a range of solid supports, proteins and lipids.

Our HAEMODEX™ and AFFINIDEX™ product ranges are ideally suited for use across a wide variety of research applications and we hold many of these items in stock for immediate purchase from our catalogue range. However, we are also able to fulfil custom requirements across all the blood group product ranges.

We have developed analytical methodology to support the manufacture and assure the quality of these products. We have a proven track record in scaling processes from milligram up to several kilograms through to cGMP manufacture of APIs in our state of the art, class 100,000 clean rooms. Dextra has successfully achieved ISO9001:2008 registration for all our activities.

There are several applications for the use of our range of blood group products, for example the blood group antigens can be used in applications for ABO incompatible transplantation, plasma purification, antibody and recombinant protein purification and quality control products.



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AFFINIDEX™

The AFFINIDEX™ columns comprise our HAEMODEX™ A and B trisaccharides linked to Sepharose 4B for use as affinity matrices in research applications. The oligosaccharides are covalently linked to the polysaccharide gel via a 10-atom spacer to overcome steric hindrance. A loading of 0.6 $\mu\text{mole/mL}$ is generally found to be sufficient, with little benefit seen from higher loadings.

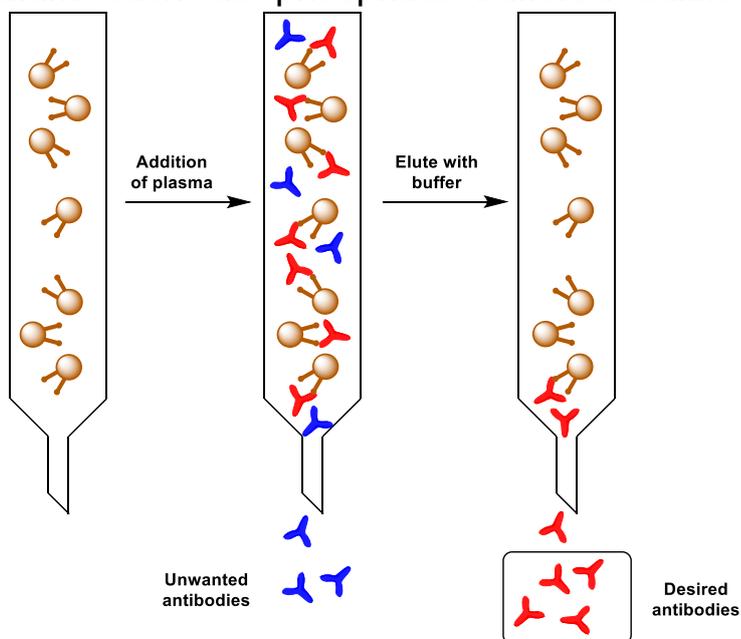
AFFINIDEX™ columns can be used to:

- Remove anti-A and anti-B antibodies
- Study polymorphism
- Measure ligand density by lectin binding
- Clean up serum samples
- Purify antibodies

These gels will bind anti-A and anti-B antibodies (haemagglutinins) from plasma or plasma derived products. The bound antibodies can also be recovered by subsequently washing the gels with a concentrated or low pH buffer (such as 0.1M glycine-HCl pH 2.2) and fully washed gels can be re-used. We recommend storing the products in a bacteriostatic medium such as phosphate buffered saline containing 0.02% sodium azide.

Pack sizes available 1 mL, 5 mL

If you require a specific affinity matrix, alternative oligosaccharide or a larger pack size please contact us, as custom columns are available.



Lindberg, L., Theinert, K., Liu, J. and Holgersson, J. (2012), Adsorption of chain type-specific ABO antibodies on Sepharose-linked A and B tetrasaccharides. *Transfusion*, 52: 2356–2367.



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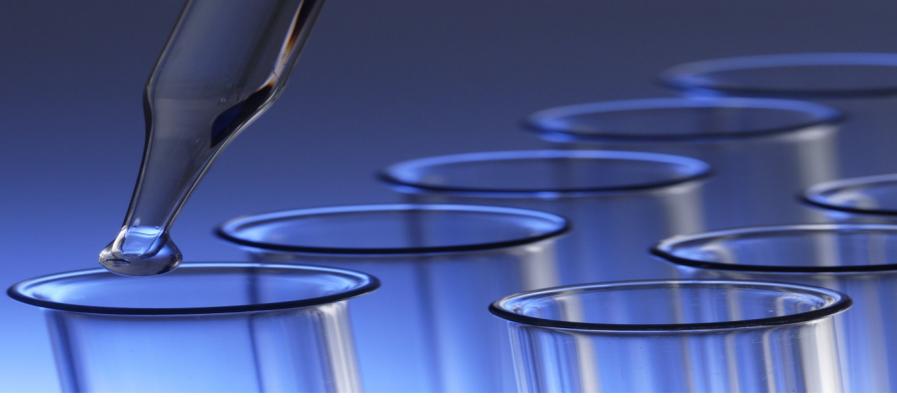
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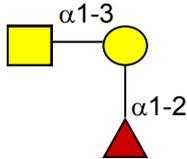
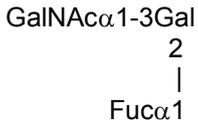
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Blood Group A

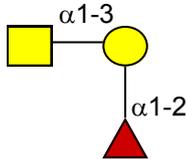
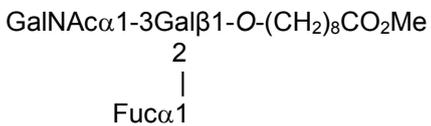
HAEMODEX™ A Trisaccharide: L305



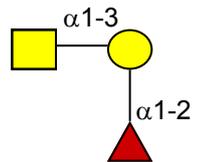
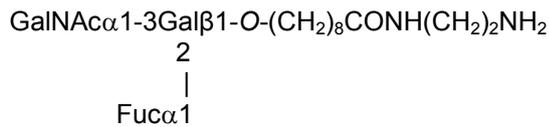
Also available as a Neoglycoprotein:

- Blood Group A Trisaccharide-BSA (6 atom spacer): NGP6305
- Blood Group A Trisaccharide-HSA (6 atom spacer): NGP8305
- Globulin Free
- Blood Group A Trisaccharide-HSA (6 atom spacer): NGP9305

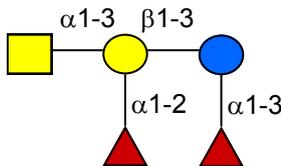
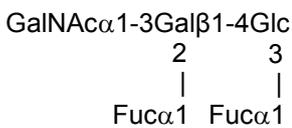
HAEMODEX™ A Trisaccharide Ester Derivative: L326



Blood Group A Trisaccharide Amine Derivative: L306

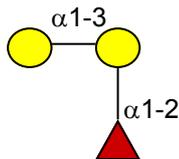
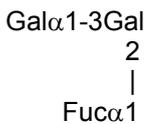


HAEMODEX™ A Pentasaccharide: L505



Blood Group B

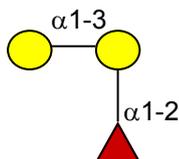
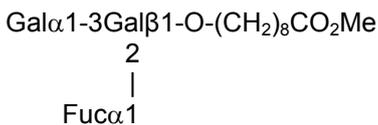
HAEMODEX™ B Trisaccharide: G323



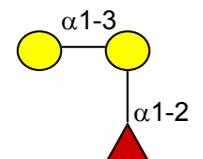
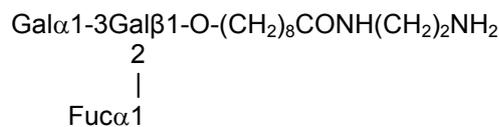
Also available as a Neoglycoprotein:

- Blood Group B Trisaccharide-BSA (3 atom spacer): NGP0323
- Blood Group B Trisaccharide-BSA (20 atom spacer): NGP1323
- Blood Group B Trisaccharide-BSA (6 atom spacer): NGP6323
- Blood Group B Trisaccharide-HSA (6 atom spacer): NGP8323
- Globulin Free
- Blood Group B Trisaccharide-HSA (6 atom spacer): NGP9323

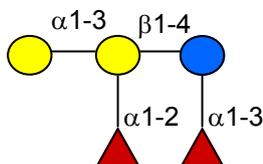
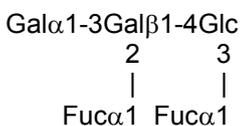
HAEMODEX™ B Trisaccharide Ester Derivative: G326



Blood Group B Trisaccharide Amine Derivative: G324



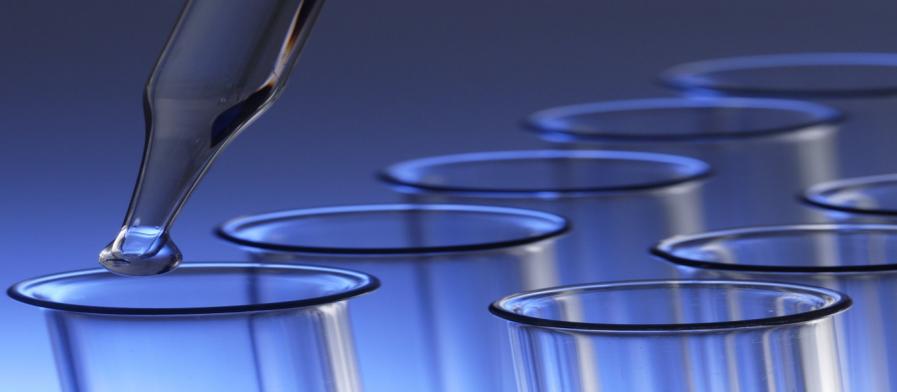
HAEMODEX™ B Pentasaccharide:





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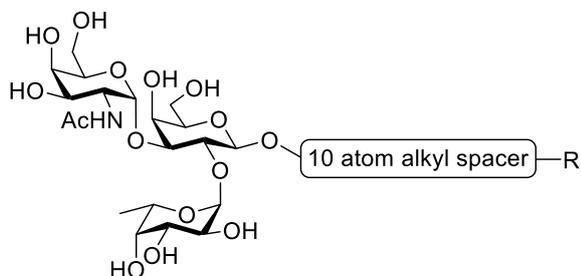
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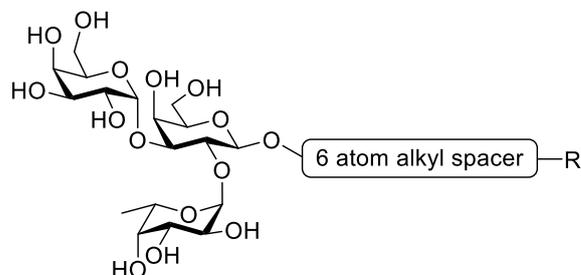
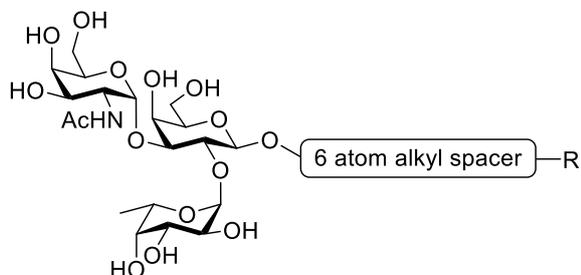
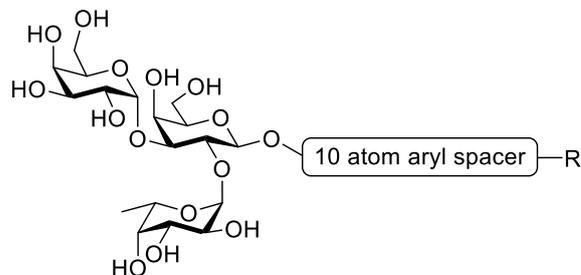
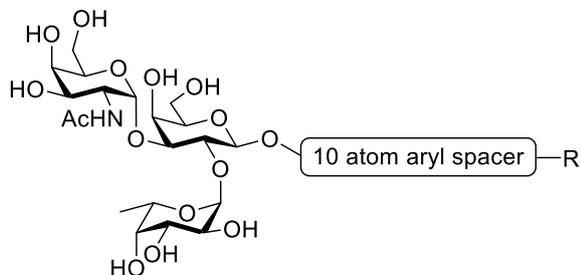
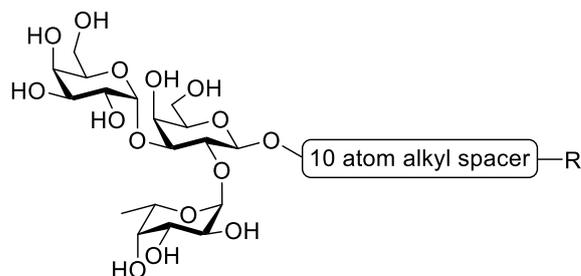
Under Development

In addition to our current catalogue range of blood group products, we also have a range of products under development. These development products feature a variety of lengths of spacer arms, to allow our products to be suitable across a wide range of applications. The products illustrated below represent some of these development compounds.

Blood Group A



Blood Group B



R = NH₂, SH, CO₂H



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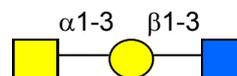
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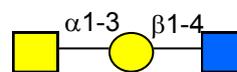
Blood Group A

Type 1 Linear Trisaccharide: LN333



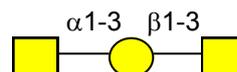
Also available as a Neoglycolipid
Type 1 Trisaccharide NGL: LN343

Type 2 Linear Trisaccharide: LN334



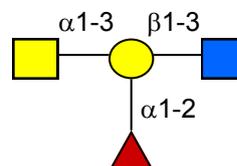
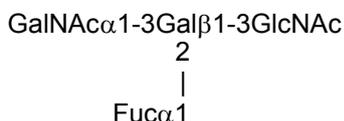
Also available as a Neoglycolipid
Type 2 Trisaccharide NGL: LN344

Type 3/4 Linear Trisaccharide: LN335



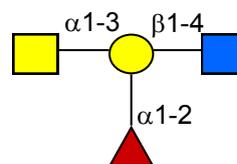
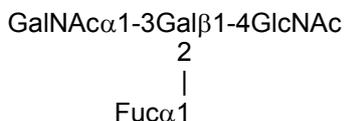
Also available as a Neoglycolipid
Type 3 Trisaccharide NGL: LN345
Type 4 Trisaccharide NGL: LN346

Type 1 Linear Tetrasaccharide: L141



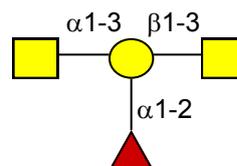
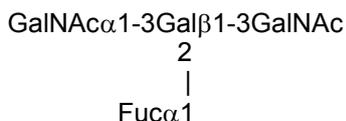
Also available as a Neoglycolipid
Type 1 Tetrasaccharide NGL: L241

Type 2 Linear Tetrasaccharide: L142



Also available as a Neoglycolipid
Type 2 Tetrasaccharide NGL: L242

Type 3/4 Linear Tetrasaccharide: L143



Also available as a Neoglycolipid
Type 3 NGL Product Code: L243
Type 4 NGL Product Code: L244



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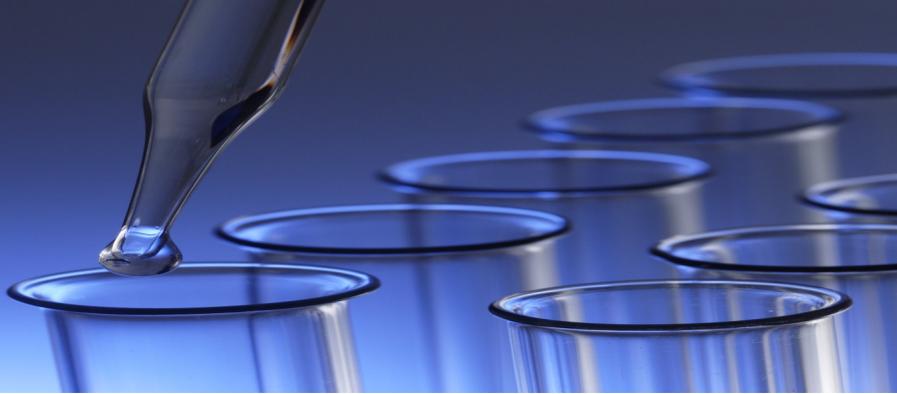
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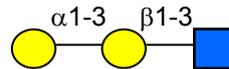
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Blood Group B

Type 1 Product Code: GN333

Gal α 1-3Gal β 1-3GlcNAc

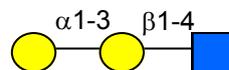


Also available as a Neoglycolipid

Type 1 NGL Product Code: GN343

Type 2 Product Code: GN334

Gal α 1-3Gal β 1-4GlcNAc

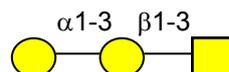


Also available as a Neoglycolipid

Type 2 NGL Product Code: GN344

Type 3/4 Product Code: GN335

Gal α 1-3Gal β 1-3GalNAc



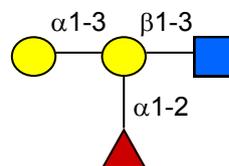
Also available as a Neoglycolipid

Type 3 NGL Product Code: GN345

Type 4 NGL Product Code: GN346

Type 1 Product Code: G421

Gal α 1-3Gal β 1-3GlcNAc
 2
 |
 Fuca1

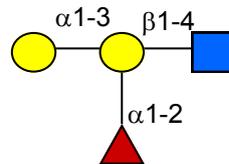


Also available as a Neoglycolipid

Type 1 NGL Product Code: G431

Type 2 Product Code: G422

Gal α 1-3Gal β 1-4GlcNAc
 2
 |
 Fuca1

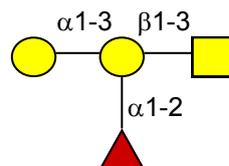


Also available as a Neoglycolipid

Type 2 NGL Product Code: G432

Type 3/4 Product Code: G423

Gal α 1-3Gal β 1-3GalNAc
 2
 |
 Fuca1



Also available as a Neoglycolipid

Type 3 NGL Product Code: G433

Type 4 NGL Product Code: G434



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Blood Group H

Blood Group H Disaccharide: L205

Fuc α 1-2Gal

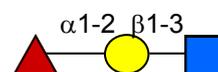


Also available as a Neoglycoprotein:

Blood Group H Disaccharide-BSA (3 atom spacer): NGP0205
Blood Group H Disaccharide-BSA (15 atom spacer): NGP6205

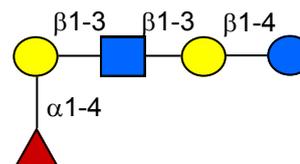
Blood Group H Type 2 Trisaccharide: LN320

Fuc α 1-2Gal β 1-4GlcNAc



Lacto-N-fucopentaose (LNFP I): L502

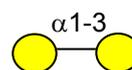
Gal β 1-3GlcNAc β 1-3Gal β 1-



Other Antigens

Galili Disaccharide: G203

Gal α 1-3Gal

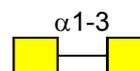


Also available as a Neoglycoprotein:

Gal α 1-3Gal-BSA (3 atom spacer): NGP0203
Gal α 1-3Gal-BSA (14 atom spacer): NGP1203
Gal α 1-3Gal-HSA (3 atom spacer): NGP2203
Gal α 1-3Gal-HSA (14 atom spacer): NGP3203

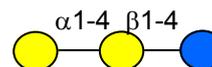
Forssman Disaccharide: GN283

GalNAc α 1-3GalNAc



Globotriose: L340

Gal α 1-4Gal β 1-4Glc

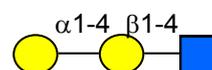


Also available as a Neoglycoprotein:

Globotriose-HSA (3 atom spacer): NGP0203

P1 Antigen: LN340

Gal α 1-4Gal β 1-4GlcNAc



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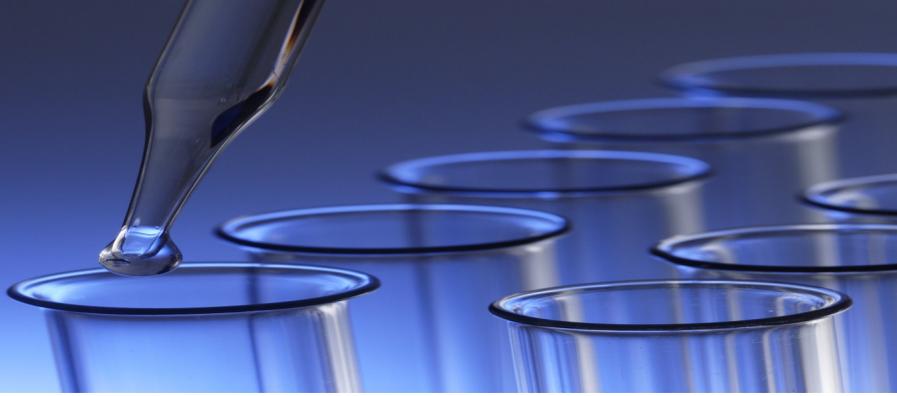
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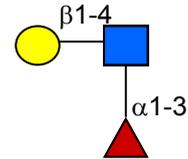
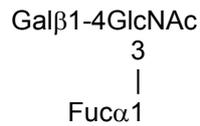
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Lewis antigens

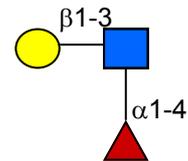
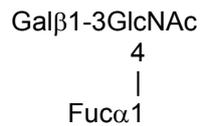
Lewis^x Trisaccharide: LN303



Also available as a Neoglycoprotein:

Lewis_x Trisaccharide-BSA (3 atom spacer): NGP0302

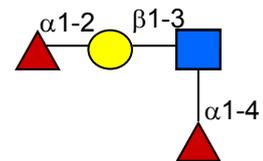
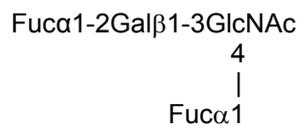
Lewis^a Trisaccharide: LN304



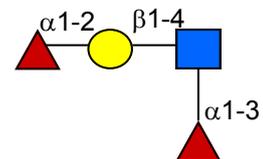
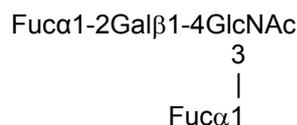
Also available as a Neoglycoprotein:

Lewis_a Trisaccharide-BSA (3 atom spacer): NGP0704

Lewis^b Tetrasaccharide: LN422



Lewis^y Tetrasaccharide: LN423



Also available as a Neoglycoprotein:

Lewis_y Trisaccharide-BSA (3 atom spacer): NGP0703



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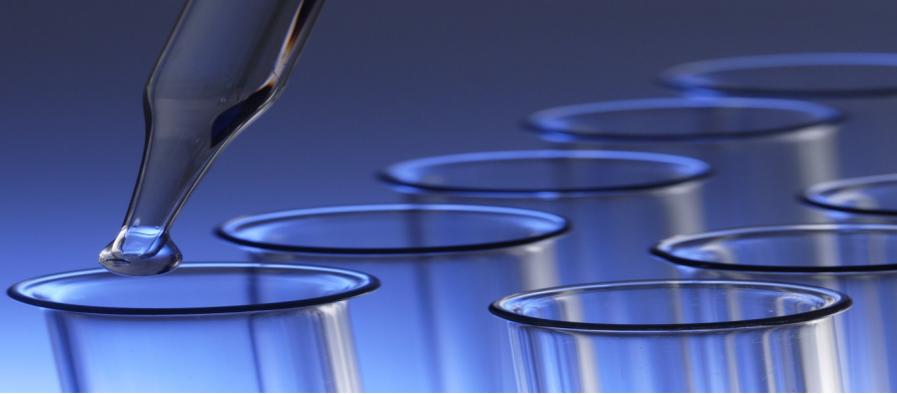
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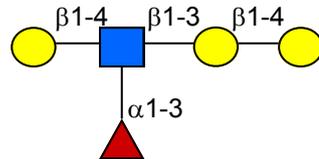
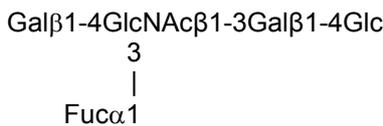
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Lewis antigens

Lacto-N-fucopentaose III (LNFP III): L504

Lewis^x pentasaccharide

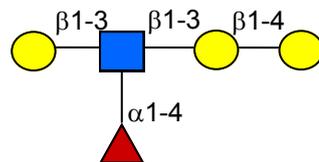
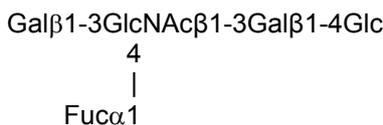


Also available as a Neoglycoprotein:

Lacto-N-fucopentaose III-BSA (3 atom spacer): NGP0502

Lacto-N-fucopentaose II (LNFP II): L503

Lewis^a pentasaccharide

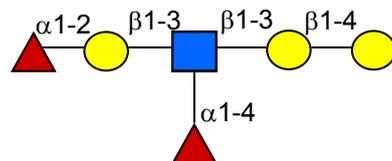
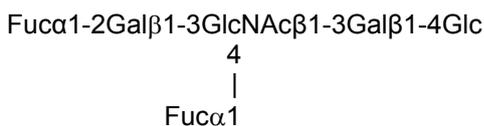


Also available as a Neoglycoprotein:

Lacto-N-fucopentaose II-BSA (3 atom spacer): NGP0501

Lacto-N-difucohexaose (LNDFH I): L602

Lewis^b pentasaccharide

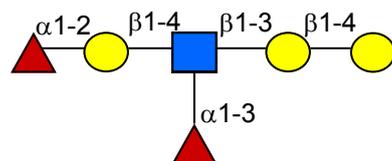
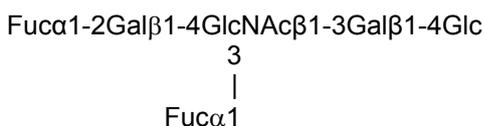


Also available as a Neoglycoprotein:

Lacto-N-difucohexaose I-BSA (3 atom spacer): NGP0601

Lacto-N-neodifucohexaose I (LNnFP I): LN607

Lewis^y Hexasaccharide



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Neoglycoproteins

We have developed exquisite technology for coupling oligosaccharides to lipids and proteins with the aim of creating powerful tools for use in a range of applications. These include:

Production of Monoclonal Antibodies

Using as little as 0.1 mg of neoglycoprotein per animal is sufficient for the generation of antibodies to the required antigen. For this application, the short spacer arm version has been recommended by some of our customers.

While we offer both Bovine Serum Albumin and Human Serum Albumin conjugates as standard catalogue items, a relatively inexpensive custom service is available for conjugate preparation to others such as Tetanus Toxoid or Keyhole Limpet Haemocyanin (KLH). Special prices are available for bulk amounts or pyrogen free material, and you are invited to contact us to discuss your requirements.

Enzyme Acceptors

Experience has shown that the use of our unique 14-atom spacer arm when using neoglycoproteins as glycosyl transferase acceptors has proved to be advantageous. For example, the ability of 14 atom spaced 3'SLN-BSA to act as an acceptor for a fucosyl transferase was comparable to the Bovine Fetuin control. Using the shorter spaced version, was essentially ineffective. We would therefore suggest that customers consider the steric influence of the protein prior to product selection.

ELISA

Neoglycoproteins are ideal for ELISA.

Please contact us for advice, or copies of technical bulletins when ordering.

Quality Assurance

All of our neoglycoproteins are analysed by matrix assisted laser desorption time of flight mass spectrometry (MALDI-TOF). This permits the determination of the number of covalently added molecules of antigen per molecule of carrier protein, together with the molecular weight distribution (maximum and minimum numbers of residues per molecule). Generally, neoglycoproteins have an average of 10 to 12 carbohydrates per molecule of protein, with a range of between 8 to 20. (The saturation point is 8-10 carbohydrates per molecule of protein, above this the feedback obtained is no greater.)



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Custom Neoglycoprotein Service

We are able to link a wide range of carbohydrates to proteins and offer a custom service that can be tailored to meet clients' specific requirements. We have made a diverse range of neoglycoproteins from simple monosaccharides to complex plant derived oligosaccharides and carbohydrate tumour antigens.

Our neoglycoproteins are frequently used as the solid phase in ELISA assays and we can provide experimental details in this application if required. We can also manufacture our existing range of neoglycoproteins on a larger scale.

Our present methods of choice link carbohydrates via the anomeric position to the ϵ -amino groups of lysine residues or to sulphhydryl groups and we offer a range of linker arms.

- The most commonly used short linker is 3-atoms and sometimes is the choice for antigen presentation, whilst the most commonly used long linker is 14-atoms, frequently preferred as an enzyme acceptor. Other linker arms are possible and are available on request.
- We aim to link at least 8 carbohydrate residues per protein molecule if the target amino acid is lysine.
- As a general rule, the coupling ratio decreases with increasing molecular weight of carbohydrate due to a combination of poorer reactivity and increasing steric hindrance.
- If the target group is sulphhydryl, then all free SH groups on the protein are usually reacted. We can discuss other coupling options, depending on specific applications.

In terms of protein the vast majority of requests are for BSA, HSA or other species' serum albumins. We can use other proteins depending on their amenability to analysis and the availability of reactive groups.

There are some restrictions that apply to the present techniques:

- The link between carbohydrate and protein is generally β , however α linkage may be possible.
- A number of carbohydrates, such as oligosaccharides with a fucose proximal to the anomeric residue may only react poorly.
- Our present minimum scale will yield 5 mg of neoglycoprotein.

If you would like to discuss your specific requirements, please contact us and we will be happy to provide you with a quotation.



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Blood Group Neoglycoproteins

Our standard pack sizes are 250 µg, 500 µg, 1 mg and 5 mg. We are able to offer custom NGPs, utilising alternative spacer arms and proteins other than BSA and HSA. Additionally we are able to comply with other specific requirements, such as globulin free proteins. Pricing for custom NGPs is available on request.

Blood Group NGPs

		Unconjugated Sugar
NGP0205 Blood Group H disaccharide-BSA	(3 atom spacer)	L205
NGP6205 Blood Group H disaccharide-BSA	(15 atom spacer)	L205
NGP6305 Blood Group A trisaccharide-BSA	(6 atom spacer)	L305
NGP8305 Blood Group A trisaccharide-HSA Globulin free	(6 atom spacer)	L305
NGP9305 Blood Group A trisaccharide-HSA	(6 atom spacer)	L305
NGP0323 Blood Group B trisaccharide-BSA	(3 atom spacer)	G323
NGP1323 Blood Group B trisaccharide-BSA	(20 atom spacer)	G323
NGP6323 Blood Group B trisaccharide-BSA	(6 atom spacer)	G323
NGP8323 Blood Group B trisaccharide-HSA Globulin free	(6 atom spacer)	G323
NGP9323 Blood Group B trisaccharide-HSA	(6 atom spacer)	G323
NGP0503 Lacto-N-fucopentaose I-BSA	(3 atom spacer)	L502

Blood group H (type 1) linked β 1-3 onto a lactose spacer

Lewis Antigen NGPs

NGP0302 Lewis _x -BSA	(3 atom spacer)	LN303
NGP0303 3-Sulfo Lewis _x -BSA	(3 atom spacer)	SSN303
NGP0304 3-Sulfo Lewis _a -BSA	(3 atom spacer)	SSN304
NGP0603 6'-Sulfo Lewis _x -BSA	(3 atom spacer)	SSN603
NGP0604 6'-Sulfo Lewis _a -BSA	(3 atom spacer)	SSN604
NGP0614 6-Sulfo Lewis _a -BSA	(3 atom spacer)	SSN614
NGP0703 Lewis _y tetrasaccharide-BSA	(3 atom spacer)	LN423
NGP0704 Lewis _a trisaccharide-BSA	(3 atom spacer)	LN304
NGP0501 Lacto-N-fucopentaose II-BSA Lewis _a trisaccharide, but with an additional lactose spacer	(3 atom spacer)	L503
NGP0502 Lacto-N-fucopentaose III-BSA Lewis _x trisaccharide, but with an additional lactose spacer	(3 atom spacer)	L504
NGP0503 Lacto-N-fucopentaose I-BSA Blood group H (type 1) linked β 1-3 onto a lactose spacer	(3 atom spacer)	L502
NGP0601 Lacto-N-difucohexaose I-BSA The Lewis _s antigen linked to a lactose spacer. Structure recognised by <i>H. pylori</i> in binding to human gastric epithelium. (Ref: Boron <i>et al</i> , <i>Science</i> , 1993, 262, 1892-1894)	(3 atom spacer)	L602
NGP0602 Lacto-N-tetraose-BSA	(3 atom spacer)	L403



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Other Blood Group Glycoconjugates

The blood group derived glycolipids (NGLs) feature a 1,2-di-O-dodecyl-sn-glycero functionality linked directly to the oligosaccharide as the algycone with a β anomeric configuration.

The majority of our biotinylated conjugates are conjugated with a long chain spacer to allow for efficient binding as the biotin binding sites are approximately 9 Å beneath the surface of the protein.

Blood Group A NGLs

	Unconjugated sugar
L241 Blood group A type 1 linear tetrasaccharide-NGL	L141
L242 Blood group A type 2 linear tetrasaccharide-NGL	L142
L243 Blood group A type 3 linear tetrasaccharide-NGL	L143
L244 Blood group A type 4 linear tetrasaccharide-NGL	L143
LN343 Blood group A type 1 linear trisaccharide-NGL	LN333
LN344 Blood group A type 2 linear trisaccharide-NGL	LN334
LN345 Blood group A type 3 linear trisaccharide-NGL	LN335
LN346 Blood group A type 4 linear trisaccharide-NGL	LN335

Blood Group B NGLs

G431 Blood group B type 1 linear tetrasaccharide-NGL	G421
G432 Blood group B type 2 linear tetrasaccharide-NGL	G422
G433 Blood group B type 3 linear tetrasaccharide-NGL	G423
G434 Blood group B type 4 linear tetrasaccharide-NGL	G423
GN343 Blood group B type 1 linear trisaccharide-NGL	GN333
GN344 Blood group B type 2 linear trisaccharide-NGL	GN334
GN345 Blood group B type 3 linear trisaccharide-NGL	GN335
GN346 Blood group B type 4 linear trisaccharide-NGL	GN335

Biotin Conjugates

NGB1205 Blood Group H type 2 trisaccharide-biotin	LN320		Gal
NGB1305 Blood Group A trisaccharide-biotin	L305		
NGB0319 Blood Group H type 1 trisaccharide-biotin	-		GalNAc
NGB1323 Blood Group B trisaccharide-biotin	G323		
NGB1302 Lewis _x -trisaccharide-biotin	LN303		Glc
NGB1703 Lewis _y tetrasaccharide-biotin	LN423		
NGB1704 Lewis _a trisaccharide-biotin	LN304		GlcNAc
NGB1705 Lewis _b tetrasaccharide-biotin	LN422		
NGB1503 Lacto-N-fucopentaose I-biotin Blood group H (type 1) linked β 1-3 onto a lactose spacer	L502		Fuc

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