



Certificate of Analysis

Fetuin Glycoprotein Standard

Cat. # : GCP-FET-100U-X4

Batch : B176-02

Nominal size : 100µg per vial

- Description:** A glycoprotein standard for use during glycan release and labeling.
- Source:** This product is purified from fetal calf serum. Fetuin is a glycoprotein present in the circulation which is synthesized by hepatocytes. Fetuin exists in a variety of glycoforms containing bi-, tri-, and tetra-antennary oligosaccharides with variable sialylation.
- Form:** Dry. Lyophilised powder.
- Molecular Weight:** 36 kDa (protein weight only)
- Amount:** 62 µg protein (In comparison to BSA standard, determined by BCA assay. Value rounded to nearest µg)
- Storage:** Refrigerate (-20°C) both before and after dissolving. This product is stable for at least 5 years as supplied.
- Shipping:** The product is shipped at ambient temperature.
- Handling:** Once dissolved avoid repeated thawing and refreezing, storage over 3 h at room temperature or above, exposure to light and long term exposure to acid as these will cause glycan desialylation.
- Safety:** This product is non-hazardous and has been purified from natural sources certified to be free of all hazardous material including pathogenic biological agents.

For research use only. Not for human or drug use

Analysis:

Fetuin glycans were released from Fetuin Glycoprotein (Cat# GCP-FET-100U) using PNGaseF.

Following release the glycans were labeled using 2-Aminobenzamide (2-AB) using the LudgerTag™ 2-AB Glycan Labeling Kit (Cat# LT-KAB-A2).

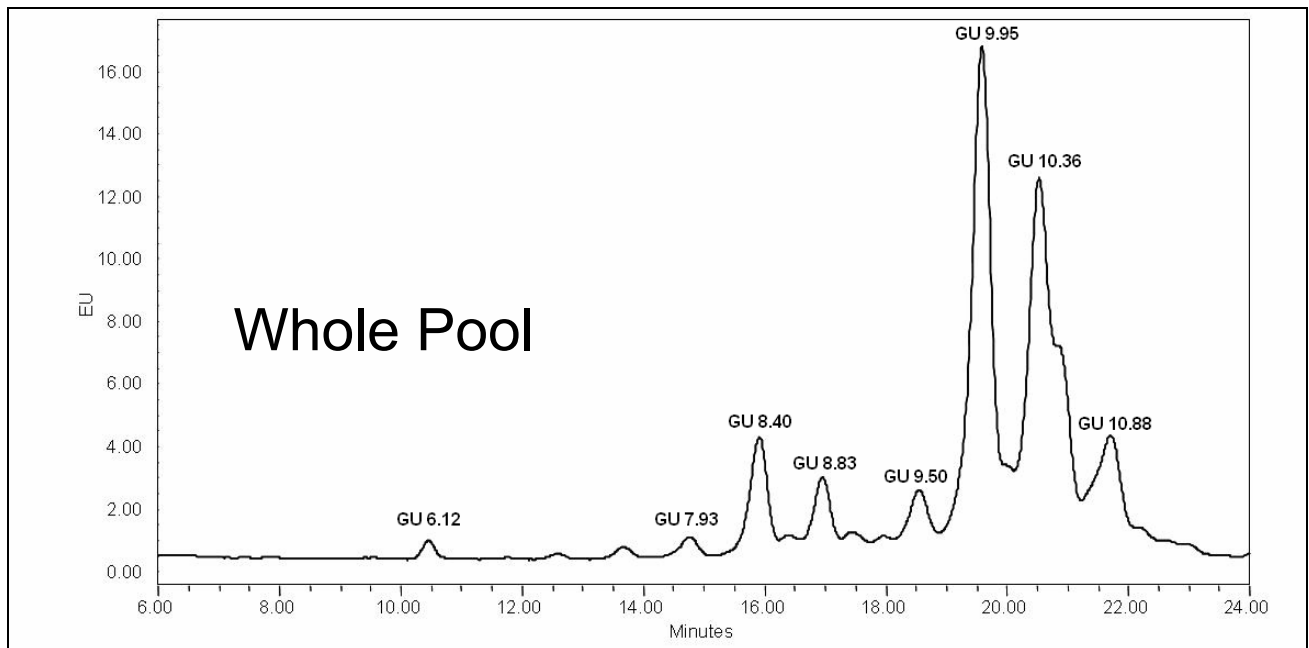


Figure 1: LudgerSepN2 (Cat. #: LS-N2-4.6x150) HPLC profile of 2-AB labelled Fetuin N-glycans, released by PNGase F from GCP-FET-100U batch B148-01.

Figure 1 shows a LudgerSepN2 HPLC profile of bovine fetuin N-glycans. To thoroughly investigate the N-glycans we first separate them based on charge on a LudgerSepC3 column (Figure 2) and then run each fraction on a LudgerSepN2 column. From these studies, combined with exoglycosidase investigation we identified the glycans shown in Table 1. For further information on Glycoprofiling please contact us at info@ludger.com

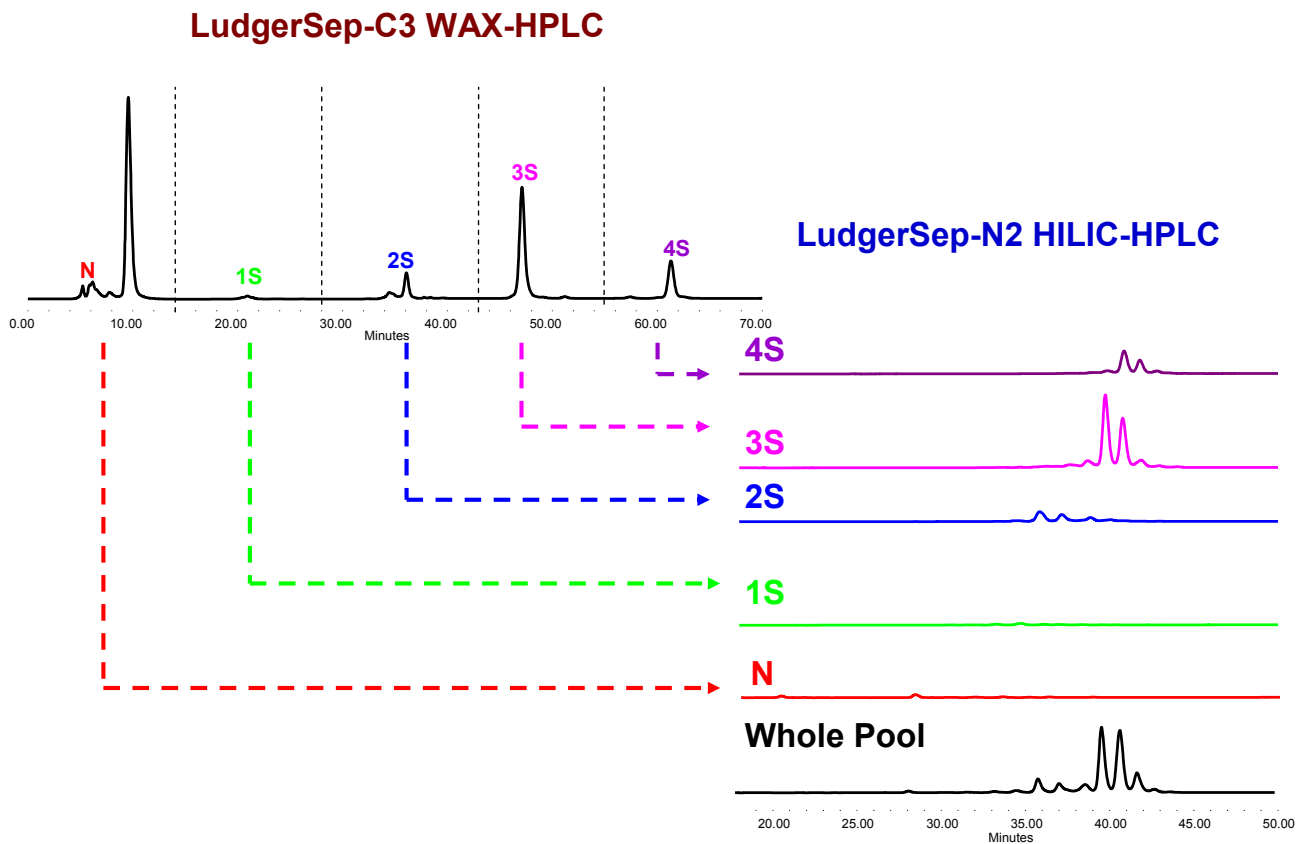


Figure 2: LudgerSep-C3 profile and subsequent LudgerSepN2 analysis of bovine fetuin PNGaseF released N-glycans from a similar batch of GCP-FET. 2-AB labelled glycans were separated on the LudgerSepC3 column and these fractions were then separated on the LudgerSepN2 column. This figure demonstrates the complexity of N-glycans present in the sample. A combination of LudgerSepC3/N2 and exoglycosidase digestion is required to identify the glycans and their relative abundance, as shown in Table 1. N- neutral glycans, 1S – monosialylated glycans, 2S – disialylated glycans, 3S – trisialylated glycans & 4S – tetrasialylated glycans.

Structure	GU	Whole Pool % Area
Bgd?	4.4	0.5
Bgd?	6.2	0.9
A2G(3)2	7	0.4
A2G(4)2	7.1	
A3G(4)2?	7.5	0.7
A2G(4)2S(6)1	7.9	1.4
A3G(4,4,3)3	8.3	6.8
A3G(4)3	8.3	
S2	8.5	5.3
A3G(4,4,3)3S1	8.6	
A3G(4)3S1	8.6	
S2	8.7	5.2
S2	9.2	
A3G(3,4)2S(3)3?	9.2	30.6
S2	9.6	
A3G(4)3S(?)3	9.6	
A3G(4,4,3)3S(3,?,?,?)4	9.6	33.4
A3G(4)3S(?)3	10	
S2	10	12.0
A3G(4,4,3)3S(3,?,?,?)4	10	
A3G(4)3S(?)3	10.4	
A3G(4,4,3)3S(3,?,?,?)4	10.4	2.3
A3G(4)3S(?)3	10.8	
A3G(4,4,3)3S(3,?,?,?)4	10.8	0.5
A3G(4,4,3)3S(3,?,?,?)4	11.3	

S2 structures include:
A2G(3)2S(?)2
A2G(4)2S(?)2
A3G2S(?)2
A3G(4,4,3)3S(?)2

Sialylated state	Relative Percentage (%)
Neutral	4
Monosialylated	2
Disialylated	13
Trisialylated	61
Tetrasialylated	20

Table 1: Summary of bovine fetuin N-glycans found in a similar batch of GCP-FET. See the end of this document for details of the glycan nomenclature used. A ? symbol indicates the linkage type is unknown. Bgd? – non-glycan peak, GU – glucose units – a system of comparing glycans to a glucose homopolymer standard. Many common N-glycans have reported GU values. A combination of GU value, mass spectrometry and exoglycosidase digestion (Figure 3), can be used to unambiguously identify most N-glycans.

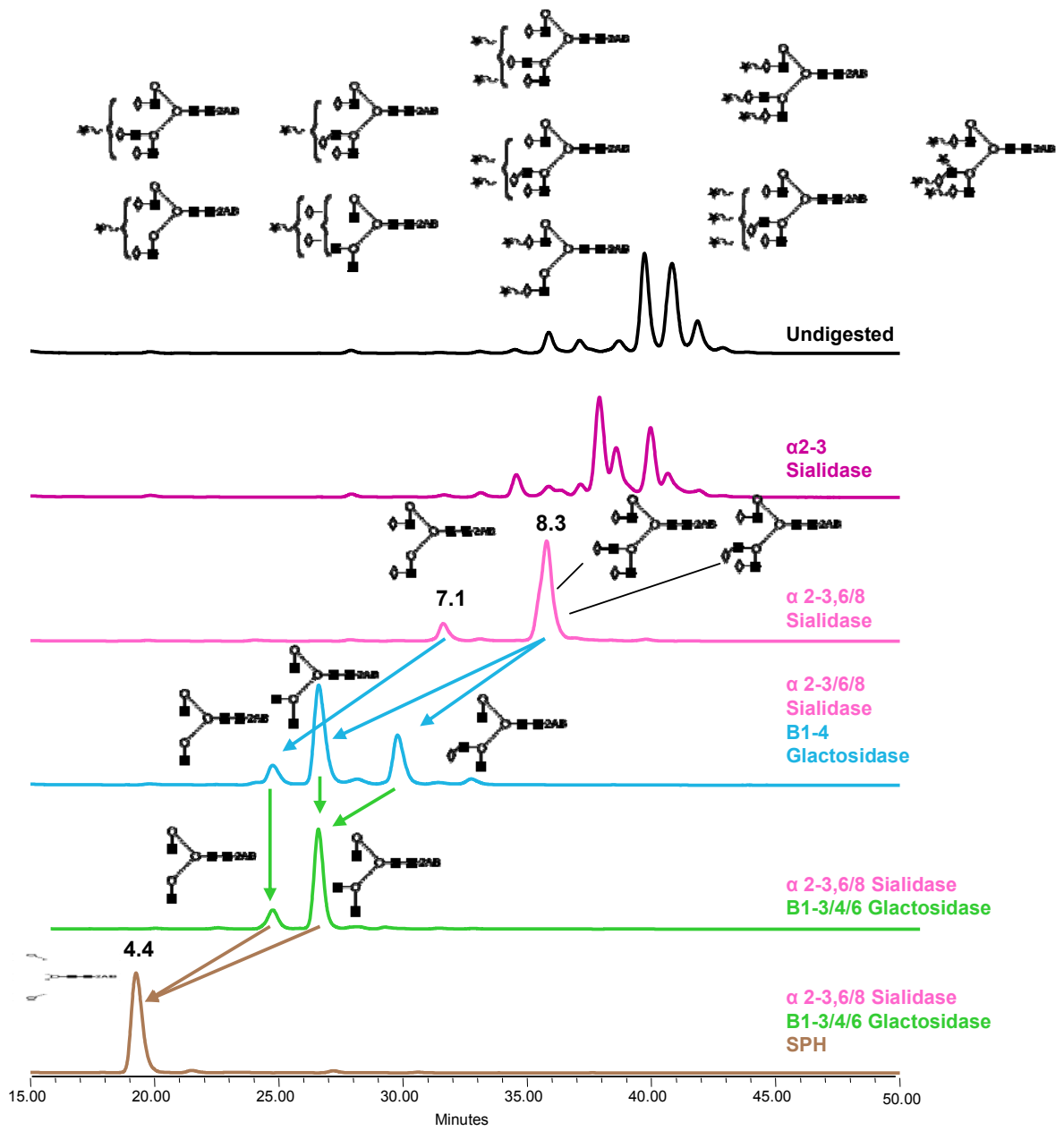


Figure 3: Example exoglycosidase analysis of bovine fetuin N-glycans from a similar batch of GCP-FET. LudgerSepN2 chromatograms are shown.

The major structures that are present **after removal** of sialic acid are:

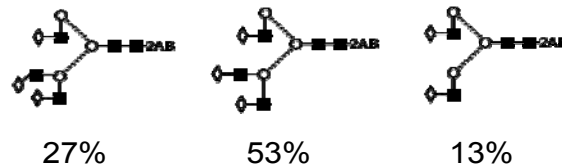


Figure 4: Relative amount of each core type of N-glycan, after removal of sialic acids, from a similar batch of GCP-FET.

Structure Abbreviations

All N-glycans have two core GlcNAcs; F at the start of the abbreviation indicates a core fucose, (6) after the F indicates that the fucose is α 1-6 linked to the inner GlcNAc; Mx, number (x) of mannose on core GlcNAcs; Ax, number of antenna (GlcNAc) on trimannosyl core; A2, biantennary with both GlcNAcs as β 1-2 linked; A3, triantennary with a GlcNAc linked β 1-2 to both mannose and the third GlcNAc linked β 1-4 to the α 1-3 linked mannose; A3', triantennary with a GlcNAc linked β 1-2 to both mannose and the third GlcNAc linked β 1-6 to the α 1-6 linked mannose; A4, GlcNAcs linked as A3 with additional GlcNAc β 1-6 linked to α 1-6 mannose; B, bisecting GlcNAc linked β 1-4 to β 1-3 mannose; Gx, number (x) of linked galactose on antenna, (4) or (3) after the G indicates that the Gal is β 1-4 or β 1-3 linked; [3]G1 and [6]G1 indicates that the galactose is on the antenna of the α 1-3 or α 1-6 mannose; Sx, number (x) of sialic acids linked to galactose; the numbers 3 or 6 in parentheses after S indicate whether the sialic acid is in an α 2-3 or α 2-6 linkage.

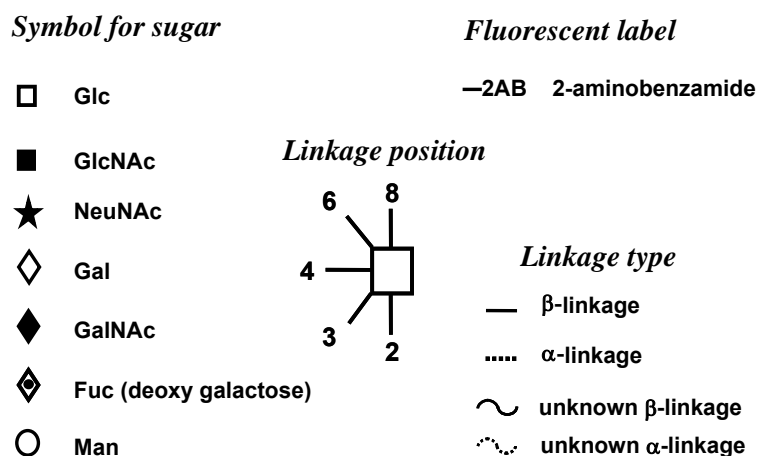


Figure 5. Symbols used to depict glycan structures

Warranties and Liabilities

Ludger warrants that the above product conforms to the attached analytical documents. Should the product fail for reasons other than through misuse Ludger will, at its option, replace free of charge or refund the purchase price. This warranty is exclusive and Ludger makes no other warrants, expressed or implied, including any implied conditions or warranties of merchantability or fitness for any particular purpose. Ludger shall not be liable for any incidental, consequential or contingent damages.

This product is intended for *in vitro* research only.

Address

Ludger Ltd, Culham Science Centre, Oxford OX14 3EB United Kingdom

Tel: +44 1865 408 554

Fax: +44 870 163 4620

Email: info@ludger.com

www.ludger.com