

## GANGLIOSIDES

**G**angliosides are sialic acid-containing glycosphingolipids. Although abundant in brain tissue, they are widely distributed in many tissues, and serve a variety of biological functions. They act as receptors for microorganisms and bacterial toxins, regulate cell growth and differentiation, and contribute to cell-cell and cell-matrix interactions (1). Recently, it has been reported that gangliosides, other sphingolipids, and cholesterol form close-packed membrane rafts that play important roles in membrane trafficking and signal transduction (2).

Due to their amphiphilic nature, gangliosides form micelles in aqueous solution. The critical micelle concentration (CMC) of a particular ganglioside depends on the composition of the ceramide tail and the number of sialic acid residues in the oligosaccharide head portion of the ganglioside, with experimental values measured from  $2 \times 10^{-8}$  M for mono-sialo-gangliosides to  $10^{-5}$  M for trisialo-gangliosides. Purified gangliosides are stable for years at +4°C and can be reconstituted in phosphate-buffered saline by sonication, or in organic solvents, e.g. chloroform:methanol (2:1).

Highly-purified gangliosides can be used as standards for cell characterization, for *in vitro* assays, and for immunization of

animals. Use of purified gangliosides as TLC standards permits the characterization of different cell type-specific surface markers. Incubation of cells with purified gangliosides allows the insertion of these glycolipids into cell membranes, specifically altering the binding capacity of membranes for bacterial toxins, growth factors, and hormones. Gangliosides can also be used for *in vitro* studies of single-cell morphology, cell-cell interaction, and differentiation. Some gangliosides have been considered "tumor markers" in tumor diagnosis. Vaccines consisting of gangliosides have been employed as one of the strategies in cancer therapy. In addition, purified gangliosides are excellent substrates and inhibitors of glycosidases and glycosyltransferases.

Anti-ganglioside antibodies have been related to certain pathological conditions, e.g. Guillian-Barre and Miller-Fisher syndromes, and cancer. Passive infusion of antibodies against gangliosides has been used to treat patients with melanoma and neuroblastoma (3).

#### References:

1. Lloyd, K.O., and Furukawa, K. 1998. *Glycoconj. J.* **15**, 627.
2. Simons, K., and Ikonen, E. 1997. *Nature* **387**, 569.
3. Hakomori, S. 1984. *Annu. Rev. Immunol.* **2**, 103.

Product	Cat. No.	Size	Comments
<b>Enzymes for Glycosphingolipid Analysis</b>			
Ceramide Glycanase, <i>Macrobodella decora</i>	219484	5 U	Releases intact glycan chain from glycosphingolipids. Glycan chain must be linked to ceramide through $\beta$ -glucosyl linkage.
Endoglycoceramidase II ACT	324722	100 mU	Releases intact glycan chain from glycosphingolipids. Can be used to remove surface glycosphingolipids without damaging living cells.
Endoglycoceramidase II, <i>Rhodococcus</i> sp., Recombinant, <i>E. coli</i>	324720	100 mU	Releases intact glycan chain from glycosphingolipids. Requires detergent and not suitable for use on living cells.
Sphingolipid Ceramide N-Deacylase, <i>Pseudomonas</i> sp.	567704	250 mU	Hydrolyzes the N-acyl linkage between fatty acids and sphingosine bases in ceramide of various sphingolipids. This enzyme can also catalyze the reverse reaction and transacylation.
<b>Antibodies against Gangliosides</b>			
Anti-Ganglioside GM <sub>1</sub> , Bovine (Rabbit)	345757	100 $\mu$ l	Polyclonal IgG, undiluted serum. Immunogen used was bovine GM <sub>1</sub> . Slightly cross-reacts with asialo-GM <sub>1</sub> . Does not cross-react with other carbohydrate epitopes. <b>Applications:</b> ELISA, Immunoblotting.
Anti-Ganglioside GM <sub>1</sub> , Asialo, Semi-Synthetic (Rabbit)	345758	100 $\mu$ l	Polyclonal IgG, undiluted serum. Immunogen used was purified semi-synthetic asialo-GM <sub>1</sub> . Does not cross-react with other carbohydrate epitopes. <b>Applications:</b> ELISA, Immunoblotting.
Anti-Ganglioside GM <sub>2</sub> , Human (Rabbit)	345759	100 $\mu$ l	Polyclonal IgG/IgM, undiluted serum. Immunogen used was purified human GM <sub>2</sub> . Does not cross-react with other carbohydrate epitopes. <b>Applications:</b> ELISA, Immunoblotting.
Anti-Ganglioside GM <sub>2</sub> , Asialo, Semi-Synthetic (Rabbit)	345761	100 $\mu$ l	Polyclonal IgG/IgM, undiluted serum. Immunogen used was purified semi-synthetic asialo-GM <sub>2</sub> . Does not cross-react with other carbohydrate epitopes. <b>Applications:</b> ELISA, Immunoblotting.
Anti-Ganglioside GD <sub>3</sub> , Bovine (Mouse)	345756	50 $\mu$ l	Monoclonal IgG, tissue culture supernatant. Clone R24. Immunogen used was bovine Ganglioside GD <sub>3</sub> . <b>Applications:</b> ELISA, Immunoblotting.

Ganglioside	Alternate Name	Cat. No.	Size	Comments
GM <sub>1</sub> , Ammonium Salt, Bovine Brain	Galβ1,3GalNAcβ1,4(Neu5Acα2,3)Galβ1,4Glcβ1,1'ceramide,NH <sub>4</sub> ; II <sup>3</sup> -(αNeu5Ac)Gg <sub>4</sub> Cer	345724	1 mg	Useful as an antigen and receptor for Cholera toxin (Cat. No. 227035), as a growth inhibition marker in fibroblasts, and as a marker for lymphoid subpopulations.
GM <sub>1</sub> , Asialo, Human Brain	Galβ1,3GalNAcβ1,4Galβ1,4Glcβ1,1'ceramide; Gg <sub>4</sub> Cer	345747	1 mg	A specific marker for NK cells. Also useful as a control for GM <sub>1</sub> .
GM <sub>1</sub> , Fucosyl, Ammonium Salt, Bovine Brain	Fucα1,2Galβ1,3GalNAcβ1,4(Neu5Acα2,3)Galβ1,4Glcβ1,1'ceramide, NH <sub>4</sub> ; IV <sup>2</sup> -(αFuc), II <sup>3</sup> -(αNeu5Ac)Gg <sub>4</sub> Cer	345753	500 µg	Useful as a tumor marker for small-cell lung cancer (SCLC).
lyso-GM <sub>1</sub> , Bovine Brain	Galβ1,3GalNAcβ1,4(Neu5Acα2,3)Galβ1,4Glcβ1,1'sphingosine; II <sup>3</sup> -(αNeu5Ac)Gg <sub>4</sub> Sphingosine	345739	1 mg	Prepared from bovine brain ganglioside GM <sub>1</sub> using Sphingolipid Ceramide N-Deacylase (Cat. No. 567704). A free amine group is produced that is amenable to conjugation with FITC, biotin, or radioactive tags.
lyso-GM <sub>2</sub> , Human Brain	GalNAcβ1,4(Neu5Acα2,3)Galβ1,4Glcβ1,1'sphingosine; II <sup>3</sup> -(αNeu5Ac)Gg <sub>3</sub> Sphingosine	345741	100 µg	Prepared from human brain ganglioside GM <sub>2</sub> using Sphingolipid Ceramide N-Deacylase (Cat. No. 567704). A free amine group is produced that is amenable to conjugation with FITC, biotin, or radioactive tags.
GM <sub>3</sub> , Ammonium Salt, Bovine Milk	Neu5Acα2,3Galβ1,4Glcβ1,1'ceramide,NH <sub>4</sub> ; II <sup>3</sup> -(αNeu5Ac)Gg <sub>2</sub> Cer	345733	500 µg	Plays important role in immunoregulation and in the biosynthesis and metabolism of higher gangliosides. Inhibits protein kinase C activity. Induces the down-regulation of CD4 molecules. Useful as a substrate for neuraminidases.
lyso-GM <sub>3</sub> , Bovine Milk	Neu5Acα2,3Galβ1,4Glcβ1,1'sphingosine; II <sup>3</sup> -(αNeu5Ac)Gg <sub>2</sub> Sphingosine	345746	100 µg	Prepared from bovine milk ganglioside GM <sub>3</sub> using Sphingolipid Ceramide N-Deacylase (Cat. No. 567704). A free amine group is produced that is amenable to conjugation with FITC, biotin, or radioactive tags.
GM <sub>4</sub> , Human Brain	Neu5Acα2,3Galβ1,1'ceramide;	345748	500 µg	Specifically localized in myelin and oligodendroglia of the central nervous system.
GD <sub>1a</sub> , Diammonium Salt, Bovine Brain	Neu5Acα2,3Galβ1,3GalNAcβ1,4(Neu5Acα2,3)Galβ1,4Glcβ1,1'ceramide,NH <sub>4</sub> ; IV <sup>3</sup> -αNeu5Ac,II <sup>3</sup> -αNeu5Ac,Gg <sub>4</sub> Cer	345736	1 mg	Useful as a differentiation marker of tumor cell growth. Inhibits protein kinase C. Readily converted to GM <sub>1</sub> by neuraminidases without detergent or bile salts.
lyso-GD <sub>1a</sub> , Bovine Brain	Neu5Acα2,3Galβ1,3GalNAcβ1,4(Neu5Acα2,3)Galβ1,4Glcβ1,1'sphingosine; IV <sup>3</sup> -αNeu5Ac, II <sup>3</sup> -αNeu5Ac,Gg <sub>4</sub> Sphingosine	345738	100 µg	Prepared from bovine brain ganglioside GD <sub>1a</sub> using Sphingolipid Ceramide N-Deacylase (Cat. No. 567704). A free amine group is produced that is amenable to conjugation with FITC, biotin, or radioactive tags.
GD <sub>1b</sub> , Diammonium Salt, Bovine Brain	Galβ1,3GalNAcβ1,4(Neu5Acα2,8Neu5Acα2,3)Galβ1,4Glcβ1,1'ceramide,NH <sub>4</sub> ; II <sup>3</sup> -(αNeu5Ac) <sub>2</sub> Gg <sub>4</sub> Cer	345751	1 mg	One of the major gangliosides in brain. Shown to be a receptor for tetanus toxin. Elevated level of anti-GD <sub>1b</sub> is associated with Guillian-Barre syndrome.
GD <sub>1b</sub> , Human Brain	Galβ1,3GalNAcβ1,4(Neu5Acα2,8Neu5Acα2,3)Galβ1,4Glcβ1,1'ceramide; II <sup>3</sup> -(αNeu5Ac) <sub>2</sub> Gg <sub>4</sub> Cer	345742	1 mg	One of the major gangliosides in brain. Shown to be a receptor for tetanus toxin. Elevated level of anti-GD <sub>1b</sub> is associated with Guillian-Barre syndrome.
GD <sub>2</sub> , Human Brain	GalNAcβ1,4(Neu5Acα2,8Neu5Acα2,3)Galβ1,4Glcβ1,1'ceramide; II <sup>3</sup> -(αNeu5Ac) <sub>2</sub> Gg <sub>3</sub> Cer	345743	500 µg	An important marker for neuroblastoma and melanoma.
GT <sub>1b</sub> , Triammonium Salt, Bovine Brain	Neu5Acα2,3Galβ1,3GalNAcβ1,4(Neu5Acα2,8Neu5Acα2,3)Galβ1,4Glcβ1,1'ceramide,NH <sub>4</sub> ; IV <sup>3</sup> -(αNeu5Ac),II <sup>3</sup> -(αNeu5Ac) <sub>2</sub> Gg <sub>4</sub> Cer	345744	1 mg	Prepared from bovine grey matter. Readily converted to GD <sub>1b</sub> -disialoganglioside by bacterial and mammalian neuraminidases without detergent or bile salts. Inhibits mitogenesis in concanavalin A-stimulated murine T cells.
GQ <sub>1b</sub> , Tetraammonium Salt, Bovine Brain	Neu5Acα2,8Neu5Acα2,3Galβ1,3GalNAcβ1,4(Neu5Acα2,8Neu5Acα2,3)Galβ1,4Glcβ1,1'ceramide,NH <sub>4</sub> ; IV <sup>3</sup> -(αNeu5Ac) <sub>2</sub> ,II <sup>3</sup> -(αNeu5Ac) <sub>2</sub> Gg <sub>4</sub> Cer	345754	100 µg	Shown to enhance spontaneous IgG, IgM, and IgA production in peripheral mononuclear cells.
Ganglioside Mixture, Ammonium Salt, Bovine Brain		345717	25 mg	Contains approximately 18% GM <sub>1</sub> , 55% GD <sub>1a</sub> , 15% GD <sub>1b</sub> , and 2% other gangliosides. Useful as a substrate for neuraminidases.

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