

Product Information

Monosialoganglioside G_{M1} from bovine brain

Catalog Numbers **G7641**, **G9652** (γ -irradiated),
G4526 (pyrene labeled)

Storage Temperature $-20\text{ }^{\circ}\text{C}$

CAS RN: 37758-47-7 (Monosialoganglioside G_{M1})

Product Description

This complex natural product is a mixture of compounds with undefined molecular weights. An approximate molecular weight of 1,540 has been calculated based on the following assumptions:

1. The sphingosyl chain is normal.
2. Stearic acid is the only fatty acid linked to the sphingosyl amino group.
3. Only acetyl (not glycolyl) residues are bound to the sugar amino group.

Structure:

Gal β (1 \rightarrow 3)/GalNAc β (1 \rightarrow 4)[Neu5Ac α (2 \rightarrow 3)]Gal β
(1 \rightarrow 4)GlcCer.

The structure for G_{M1} is also indicated as G_{M1a}. G_{M1a} is the structure found in mammalian brain and is generally referred to as G_{M1}.¹

Monosialoganglioside G_{M1} is a major sialoglycolipid of neuronal membranes that modulates calcium homeostasis.² It binds to cholera toxin B subunit, resulting in stimulation of adenylate cyclase in a wide variety of cell types.³ After cholera toxin binds to membrane associated monosialoganglioside G_{M1}, the A subunit of cholera toxin is translocated to the cell interior, where it catalyzes the ADP ribosylation of the membrane associated Gs subunit of adenylate cyclase.⁴ In addition, binding of cholera toxin to monosialoganglioside G_{M1} causes translocation of NF- κ B and activation of dendritic cells.⁵

Monosialoganglioside G_{M1} was one of many mono- and oligosaccharide ligands studied for their affinity for NKR-P1, a membrane protein on natural killer cells, which contains an extracellular Ca²⁺-dependent lectin domain.⁶ Monosialoganglioside G_{M1} is effective in partially correcting the consequences of neuroinjury in a number of *in vivo* and *in vitro* model systems.⁷

Accumulation of G_{M1}, caused by a defect of acid hydrolases, leads to the G_{M1} gangliosidosis, which is a lethal lysosomal disease.⁸ It was also found to have a regulatory role in amyloid precursor protein processing pathways associated with Alzheimer's disease⁹ and possible involvement in the pathogenesis of demyelination in relapsing-remitting multiple sclerosis.¹⁰

Neuraminidase from *Arthrobacter ureafaciens* has a 100-fold higher specificity for the sialidase-resistant ganglioside G_{M1} than the sialidase from *C. perfringens*. In the absence of detergents, neuraminidase showed very low activity, but with sodium cholate at 3 times the G_{M1} molar concentration, the hydrolysis was most effective.¹¹

The fluorescent monosialoganglioside G_{M1}-pyrene labeled was used to monitor interactions between cholera toxin and its receptor.^{12,13}

Monosialoganglioside G_{M1} is prepared by a modification of a published procedure.¹⁴ It is isolated from bovine brain by extraction and solvent fractionation methods. The final purification is done by HPLC on silica gel allowing no buffer salts to be used for the purification.

The recommended TLC spray reagent for detection on silica gel plates is the naphthoresorcinol-sulfuric acid spray for sugars.¹⁵

Precautions and Disclaimer

This product is for R&D use only, not for drug, household, or other uses. Please consult the Material Safety Data Sheet for information regarding hazards and safe handling practices.

Preparation Instructions

Gangliosides, including monosialoganglioside G_{M1}, are soluble in dimethylformamide, tetrahydrofuran, methanol and insoluble in non-polar solvents. Gangliosides form micelles in aqueous solution.¹⁶

Storage/Stability

Monosialoganglioside G_{M1} is stable in methanol for a few days at room temperature, several weeks in the refrigerator and months in the freezer.

References

1. Ledeen, R.W., and Yu, R.K., Gangliosides: structure, isolation, and analysis. *Methods Enzymol.*, **83**, 139-191 (1982).
2. Wu, G. et al., Trophic effect of cholera toxin B subunit in cultured cerebellar granule neurons: modulation of intracellular calcium by G_{M1} ganglioside., *J. Neurosci Res.*, **44**, 243-54 (1996).
3. Kurosky, A., et al., Covalent structure of the β chain of cholera enterotoxin., *J. Biol. Chem.*, **252**, 7257-7264 (1977).
4. Mekalanos, J. J., Production and purification of cholera toxin., *Methods Enzymol.*, **165**, 169-175 (1988).
5. Kawamura, Y.I., et al., Cholera toxin activates dendritic cells through dependence on G_{M1}-ganglioside which is mediated by NF- κ B translocation., *Eur. J. Immunol.*, **33**, 3205-12 (2003).
6. Bezouska, K., et al., Oligosaccharide ligands for NKR-P1 protein activate NK cells and cytotoxicity., *Nature*, **372**, 150-157 (1994).
7. Hadjiconstantinou, M. and Neff, N.H., G_{M1} ganglioside: *in vivo* and *in vitro* trophic actions on central neurotransmitter systems., *J. Neurochem.* **70**, 1335-45 (1998).
8. Satoh, H., et al., Increased concentration of G_{M1}-ganglioside in cerebrospinal fluid in dogs with G_{M1}- and G_{M2}-gangliosidoses and its clinical application for diagnosis., *J. Vet. Diagn. Invest.* **16**, 223-6 (2004)
9. Zha, Q., et al., G_{M1} ganglioside regulates the proteolysis of amyloid precursor protein., *Mol. Psychiatry*, **9**, 946-52 (2004).
10. Zaprianova, E., et al., Serum IgG and IgM ganglioside G_{M1} antibodies in patients with multiple sclerosis., *Ideggyogy Sz.*, **57**, 94-9 (2004)
11. Saito, M., et al., Action of *Arthrobacter ureafaciens* sialidase on sialoglycolipid substrates. Mode of action and highly specific recognition of the oligosaccharide moiety of ganglioside G_{M1}. *J. Biol. Chem.*, **254**, 7845-7854 (1979).
12. Picking, W.D., Interaction of pyrene-labeled monosialoganglioside G_{M1} micelles with cholera toxin. *Biochem. Biophys. Res. Commun.*, **195**, 1153-1158 (1993).
13. McCann, J. A., et al., Conformational changes in cholera toxin B subunit-Ganglioside G_{M1} complexes are elicited by environmental pH and evoke changes in membrane structure. *Biochem.*, **36**, 9169-9178 (1997).
14. Svennerholm in *Methods in Carbohydrate Chemistry*, Vol. VI, 464 (1970).
15. *Thin Layer Chromatography: A Laboratory Handbook*, 2nd ed., Stahl, E., ed., Springer-Verlag (New York, NY: 1969), p. 888.
16. The Merck Index, 13th ed., No. 4379.

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