

Product information

Leaflet

GlyCare™ 3SL and 6SL

Human Milk Oligosaccharides brought to you by
dsm-firmenich, at the forefront of HMO innovation

Early life nutrition innovation from dsm-firmenich

Providing the best infant nutrition is vital for all families. That's why dsm-firmenich is proud to offer GlyCare™ HMOs. These compounds are developed with science-backed quality and safety at their core. As a fully integrated manufacturer with one of the broadest HMO offerings, dsm-firmenich can reliably provide ease-of-scale no matter the size of your business. Partner with us to get your products one step closer to what nature intended.

Partner with dsm-firmenich for access to our broad portfolio of products, customized solutions, and expert services aimed at supporting your entire product life cycle, from concept to consumption.

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Human Milk Oligosaccharides (HMOs): delivering the benefits nature intended

Uniquely human

- HMOs are complex carbohydrates found in human breastmilk
- No other mammal has near the concentration and complexity of structures in their milk^{1–6}

Abundance and diversity in human milk

- 3rd largest component of human milk⁷
- >200 different HMOs identified in human milk, a diversity not seen in other animal milks^{4–6}
- Variation occurs over lactation period, by maternal genetics, geographic region, and ethnicity^{8,9}

Complex structures with potential functional benefits

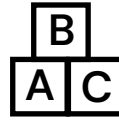
- Help establish a balanced early-life microbiota^{10,11}
- Contribute to immune system support^{12–16}

3'Sialyllactose (3'SL) and 6'Sialyllactose (6'SL) are sialylated HMOs found in both colostrum and mature milk^{19,20}

- Human milk is a rich source of sialic acid (~1 g/L), while cow's milk formulas naturally contain small amounts (0–0.25 g/L).²¹
- Emerging science indicates that sialylated HMOs may be utilized as building blocks for the brain and may have a nutritional role in brain development in early infancy.^{22,23}

HMO functionality is structure-specific: not all HMOs serve the same purpose^{24,25}

Potential functional benefits of GlyCare™ 3SL and 6SL, as demonstrated primarily in pre-clinical studies



- Emerging evidence suggests a nutritional role in supporting brain development and health^{23,26,27}



- May support normal immune function^{28–3}
- Stimulates the growth of beneficial bacteria, including bifidobacteria, alone or when combined^{34–36}
- Emerging evidence suggests a possible role in deflecting the adhesion of undesirable microbes to cell walls^{28–32}



- Emerging evidence suggests potential role in protecting cells in the intestines and skin^{37,38}

Breastmilk – the gold standard

Breastmilk provides nutrients that are vital for an infant's growth and development and sets the standard in infant feeding.^{39,40} Human milk oligosaccharides (HMOs) are the third largest solid component of human milk after lipids and lactose and a key differentiating feature between human milk and cow's milk. The unique structure, concentration, and variety of oligosaccharides in human milk sets them apart from those found in cow's milk.^{41,42} Differences in health outcomes between breastfed and formula-fed infants may partly be explained by these features.^{8,41,43,44}

HMOs stimulate the growth of beneficial bacteria

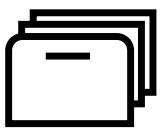
- When ingested, HMOs resist digestion and reach the colon mostly intact^{42,45}
- By selectively feeding the gut with beneficial bacteria, HMOs enhance the growth of helpful bacteria like bifidobacteria and limit the nutrient supply for undesirable organisms^{44,47,48}
- HMOs also support production of short chain fatty acids and other metabolites that work to create a community of healthy microbes in the GI tract⁴⁷⁻⁵⁰

GlyCare™ 3SL and GlyCare™ 6SL Product Information

- 5 years of shelf life from production date
- Purity levels from 88%
- White to off-white, homogenous, amorphous powder with a neutral to slightly sweet taste
- Contains up to 12% lactose[§]
- Manufactured without contact to latex, bisphenol A, or phthalates
- This product is free from: Animal derived ingredients (ADI), Allergens (except milk),[§] Genetically modified organisms (GMO)[¥]

§ according to EC regulation 1169/2011 annex II

¥ according to EC regulation 1829/2003 and 1830/2003



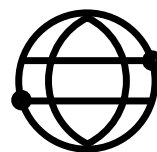
Broad product portfolio and a leading HMO innovator



Proven, reliable supply that scales with you



Highest safety and quality standards



Largest global market access: 160+ countries*

* We are continuously expanding our global approval footprint across application areas. For more details, please ask for our Regulatory Overview.

For more information, get in touch with your dsm-firmenich representative, or visit www.dsm-firmenich.com/health-nutrition-care

dsm-firmenich GlyCare™ HMOs are produced to the highest quality of certifications, approvals, and procedures

The full GlyCare™ HMO portfolio

- GlyCare™ 2FL
- GlyCare™ 3SL
- GlyCare™ LNnT
- GlyCare™ LNT
- GlyCare™ 2FL/DFL
- GlyCare™ 3FL
- GlyCare™ 6SL
- GlyCare™ LNFP I



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References

1. T. Urashima, T. Saito, T. Nakamura, and M. Messer, "Oligosaccharides of milk and colostrum in non-human mammals," *Glycoconjugate Journal*, vol. 18, no. 5, Springer, pp. 357–371, 2001, doi: 10.1023/A:1014881913541.
2. D. S. Newburg et al., "Milk oligosaccharides across species," *Pediatr. Res.*, vol. 45, no. 5, pp. 745–745, May 1999, doi: 10.1203/00006450-199905010-00044.
3. S. Albrecht et al., "A comparative study of free oligosaccharides in the milk of domestic animals," *Br. J. Nutr.*, vol. 111, no. 7, pp. 1313–1328, Apr. 2014, doi: 10.1017/S0007114513003772.
4. N. Tao et al., "Evolutionary glycomics: Characterization of milk oligosaccharides in primates," *J. Proteome Res.*, vol. 10, no. 4, pp. 1548–1557, 2011, doi: 10.1021/pr1009367.
5. T. Urashima, S. Asakuma, F. Leo, K. Fukuda, M. Messer, and O. T. Oftedal, "The Predominance of Type I Oligosaccharides Is a Feature Specific to Human Breast Milk," *Am. Soc. Nutr. Adv. Nutr.*, vol. 3, pp. 473S–482S, 2012, doi: 10.3945/an.111.001412.
6. P. Gagneux et al., "Human-specific Regulation of fucose-linked Sialic Acids," *J. Biol. Chem.*, vol. 278, no. 48, pp. 48245–48250, 2003, doi: 10.1074/jbc.M309813200.
7. Hegar, B., Wibowo, Y., Basrowi, R. W., Ranuh, R. G., Sudarmo, S. M., Munasir, Z., Atthiyah, A. F., Widodo, A. D., Supriatmo, Kadim, M., Suryawan, A., Diana, N. R., Manoppo, C., & Vandenplas, Y. (2019). The Role of Two Human Milk Oligosaccharides, 2'-Fucosyllactose and Lacto-N-Neotetraose, in Infant Nutrition. *Pediatric gastroenterology, hepatology & nutrition*, 22(4), 330–340. <https://doi.org/10.5223/pghn.2019.22.4.330>
8. Vandenplas, Y., Berger, B., Carnielli, V. P., Ksiazek, J., Lagström, H., Sanchez Luna, M., Migacheva, N., Mosselmans, J., Picaud, J., Pössner, M., Singhal, A., & Wabitsch, M. (2018). Human Milk Oligosaccharides: 2'-Fucosyllactose (2'-FL) and Lacto-N-Neotetraose (LNnT) in Infant Formula. *Nutrients*, 10(9), 13390. [doi:10.3390/nu100913390](https://doi.org/10.3390/nu100913390)
9. Soyylmaz, Buket, et al. "The Mean of Milk: A Review of Human Milk Oligosaccharide Concentrations throughout Lactation." *Nutrients*, 2021, doi:10.3390/nu13082737
10. Berger, Bernard, et al. "Linking Human Milk Oligosaccharides, Infant Fecal Community Types, and Later Risk to Require Antibiotics." *MBio*, vol. 11, no. 2, 2020, pp. 1–18, doi:10.1128/mBio.03196-19.
11. Bezirtzoglou, Eugenia, et al. "Anaerobe Microbiota pro FI Le in Feces of Breast- and Formula-Fed Newborns by Using FI Uroescence in Situ Hybridization (FISH)." *Anaerobe*, vol. 17, no. 6, Elsevier Ltd, 2011, pp. 478–82, doi:10.1016/j.anaerobe.2011.03.009.
12. Illiano P, Brambilla R, Parolini C. The mutual interplay of gut microbiota, diet and human disease. *Febs J.* 2020;287(5):833–855.
13. Altveq S, Yildiz HK, Vural HC. Interaction of the microbiota with the human body in health and diseases. *Biosci Microbiota Food Health.* 2020;39(2):23–32.
14. Zhang, Bin, et al. "Human Milk Oligosaccharides and Infant Gut Microbiota: Molecular Structures, Utilization Strategies and Immune Function." *Carbohydrate Polymers*, vol. 276, no. October 2021, Elsevier Ltd, 2022, p. 118738, doi:10.1016/j.carbpol.2021.118738.
15. Zuurveld, Marit, et al. "Immunomodulation by Human Milk Oligosaccharides: The Potential Role in Prevention of Allergic Diseases." *Frontiers in Immunology*, vol. 11, no. May, 2020, doi:10.3389/fimmu.2020.00801.
16. Derya, S. M., Spiegel, H., Honisch, F. G., Morozov, V., Schrotten, H., Jennwein, S., & Parschat, K. (2020). Biotechnologically produced fucosylated oligosaccharides inhibit the binding of human noroviruses to their natural receptors. *Journal of Biotechnology*, 318(November 2019), 31–38. <https://doi.org/10.1016/j.jbiotec.2020.05.001>
17. Koromylova, A., Tripathi, S., Morozov, V., Schrotten, H., & Hansman, G. S. (2017). Human norovirus inhibition by a human milk oligosaccharide. *Virology*, 508(April), 81–89. <https://doi.org/10.1016/j.virol.2017.04.032>
18. Yang B, Chuang H, & Yang K. D. (2009). Sialylated glycans as receptor and inhibitor of enterovirus 71 infection to DLD-1 intestinal cells. *Virology Journal*, 6, 1–6. <https://doi.org/10.1186/1743-422X-6-141>
19. Austin S, Benet T. Quantitative determination of non-lactose milk oligosaccharides. *Anal Chim Acta.* 2018;1010:86–96.
20. Coppa GV, Pierani P, Zampini L, Carloni I, Carlucci A, Gabrielli O. Oligosaccharides in human milk during different phases of lactation. *Acta Paediatr Suppl.* 1999;88(430):89–94.
21. Wang B, Brand-Miller J, McVeagh P, Petocz P. Concentration and distribution of sialic acid in human milk and infant formulas. *Am J Clin Nutr.* 2001;74(4):510–515.
22. Wang B, McVeagh P, Petocz P, Brand-Miller J. Brain ganglioside and glycoprotein sialic acid in breastfed compared with formula-fed infants. *Am J Clin Nutr.* 2003;78(5):1024–1029.
23. Jacobi SK, Yatsunenka T, Li D, et al. Dietary Isomers of Sialyllactose Increase Ganglioside Sialic Acid Concentrations in the Corpus Callosum and Cerebellum and Modulate the Colonic Microbiota of Formula-Fed Piglets. *J Nutr.* 2016;146(2):200–208.
24. Bode L, Jantscher-Krenn E. Structure-function relationships of human milk oligosaccharides. *Adv Nutr.* 2012b;3(3):383S–391S.
25. Jantscher-Krenn E, Bode L. Human milk oligosaccharides and their potential benefits for the breast-fed neonate. *Minerva Pediatr.* 2012;64(1):83–99.
26. Tarr AJ, Galley JD, Fisher SE, Chichlowski M, Berg BM, Bailey MT. The prebiotics 3'Sialyllactose and 6'Sialyllactose diminish stressor-induced anxiety-like behavior and colonic microbiota alterations: Evidence for effects on the gut-brain axis. *Brain Behav Immun.* 2015;50:166–177.
27. Sakai F, Ikeuchi Y, Urashima T, Fujihara M, Ohtsuki K, Yanahira S. Effects of Feeding Sialyllactose and Galactosylated $\langle \text{p} \rangle \text{N} \langle / \text{p} \rangle \text{Acetylnauraminic Acid on Swimming Learning Ability and Brain Lipid Composition in Adult Rats. Journal of Applied Glycoscience. 2006;53(4):249–254.}$
28. Laucirica DR, Triantis V, Schoemaker R, Estes MK, Ramani S. Milk Oligosaccharides Inhibit Human Rotavirus Infectivity in MA104 Cells. *J Nutr.* 2017;147(9):1709–1714.
29. Korhonen TK, Vaisanen-Rhen V, Rhen M, Pare A, Parkkinen J, Finne J. Escherichia coli fimbriae recognizing sialyl galactosides. *J Bacteriol.* 1984;159(2):762–766.
30. Evans DG, Evans DJ, Jr., Moulds JJ, Graham DY. N-acetylnauraminylactose-binding fibrillar hemagglutinin of *Campylobacter pylori*: a putative colonization factor antigen. *Infect Immun.* 1988;56(11):2896–2906.
31. Hirno S, Kelm S, Iwersen M, et al. Inhibition of *Helicobacter pylori* sialic acid-specific haemagglutination by human gastrointestinal mucins and milk glycoproteins. *FEMS Immunol Med Microbiol.* 1998;20(4):275–281.
32. Huang ML, Cohen M, Fisher CJ, Schooley RT, Gagneux P, Godula K. Determination of receptor specificities for whole influenza viruses using multivalent glycan arrays. *Chem Commun (Camb).* 2015;51(25):5326–5329.
33. Marotta M, Ryan JT, Hickey RM. The predominant milk oligosaccharide 6'-sialyllactose reduces the internalisation of *Pseudomonas aeruginosa* in human pneumocytes. *Journal of Functional Foods.* 2014;6:367–373.
34. Moon JS, Joo W, Ling L, Choi HS, Han NS. In vitro digestion and fermentation of sialyllactoses by infant gut microflora. *Journal of Functional Foods.* 2016;21:497–506. [doi:10.1016/j.jff.2016.04.004](https://doi.org/10.1016/j.jff.2016.04.004)
35. Ruiz-Moyano S, Tatten SM, Garrido DA, et al. Variation in consumption of human milk oligosaccharides by infant gut-associated strains of bifidobacterium breve. *Applied and Environmental Microbiology.* 2013;79(19):6040–6049.
36. Nishiyama K, Nagai A, Uribayashi K, Yamamoto Y, Mukai T, Okada N. Two extracellular sialidases from *Bifidobacterium bifidum* promote the degradation of sialyl-oligosaccharides and support the growth of *Bifidobacterium breve*. *Anaerobe.* 2018;52:22–28.
37. Sodhi CP, Wipf P, Yamaguchi Y, et al. The human milk oligosaccharides 2'-fucosyllactose and 6'-sialyllactose protect against the development of necrotizing enterocolitis by inhibiting toll-like receptor 4 signaling. *Pediatr Res.* 2020.
38. Kang LJ, Oh E, Cho C, et al. 3'-Sialyllactose prebiotics prevents skin inflammation via regulatory T cell differentiation in atopic dermatitis mouse models. *Sci Rep.* 2020;10(1):5603.
39. Lessen R, Kavanagh K. Position of the academy of nutrition and dietetics: promoting and supporting breastfeeding. *J Acad Nutr Diet.* 2015;15(3):444–449.
40. Johnston M, Landers S, Noble L, Szucs K, L. V. Breastfeeding and the use of human milk. *Pediatrics.* 2012;129(3):e827–841.
41. Urashima T, Taufik E, Fukuda K, Asakuma S. Recent advances in studies on milk oligosaccharides of cows and other domestic farm animals. *Biosci Biotechnol Biochem.* 2013;77(3):455–466.
42. Bode L. Human milk oligosaccharides: every baby needs a sugar mama. *Glycoconjugate Journal.* 2012a;22(9):1147–1162.
43. Chouraqui JP. Does the contribution of human milk oligosaccharides to the beneficial effects of breast milk allow us to hope for an improvement in infant formulas? *Crit Rev Food Sci Nutr.* 2020;1–12.
44. Cheng L, Akkerman R, Kong C, Walvoort MTC, de Vos P. More than sugar in the milk: human milk oligosaccharides as essential bioactive molecules in breast milk and current insight in beneficial effects. *Crit Rev Food Sci Nutr.* 2020;1–17.
45. Kunz C. Historical aspects of human milk oligosaccharides. *Adv Nutr.* 2012;3(3):430S–439S.
46. Asakuma S, Hatakeyama E, Urashima T, et al. Physiology of consumption of human milk oligosaccharides by infant gut-associated bifidobacteria. *J Biol Chem.* 2011;286(40):34583–34592.
47. Schwab C, Ruscheweyh HJ, Bunesova V, Pham VT, Beerenwinkel N, Lacroix C. Trophic Interactions of Infant Bifidobacteria and *Eubacterium hallii* during L-Fucose and Fucosyllactose Degradation. *Front Microbiol.* 2017;8:95.
48. Gibson GR, Wang X. Regulatory effects of bifidobacteria on the growth of other colonic bacteria. *J Appl Bacteriol.* 1994;77(4):412–420.
49. Smilowitz JT, Lebrilla CB, Mills DA, German JB, Freeman SL. Breast milk oligosaccharides: structure-function relationships in the neonate. *Annu Rev Nutr.* 2014;34:143–169.
50. Lawson MAE, O'Neill LJ, Kujawska M, et al. Breast milk-derived human milk oligosaccharides promote *Bifidobacterium* interactions within a single ecosystem. *ISME J.* 2020;14(2):635–648.

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