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 milk1–6

Abundance and diversity in human milk

- 3rd largest component of human milk[7]
- >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 skin37,38

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 tract[47–50]

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

ISO 9001:2015

FSSC 22000

SMETA

Halal

Kosher

The full GlyCare™ HMO portfolio

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

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 α2-6-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., Ksiazyk, J., Lagström, H., Sanchez Luna, M., Migacheva, N., Mosselmans, J., Picaud, J., Possner, M., Singhal, A., & Wabitsch, M. (2018). Human Milk Oligosaccharides: 2'-Fucosyllactose (2'-FL) and Lacto-N-Neotetraose (LNnT) in Infant Formula. Nutrients, 10(9)10.3390/ nu10091161
9. Soyyılmaz, 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 Fl Uorescence 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. Altveş 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., Hanisch, F. G., Morozov, V., Schroten, H., Jennewein, 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. Koromyslova, A., Tripathi, S., Morozov, V., Schroten, 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, Yatsunenko 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 N-Acetylneuraminic 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, Pere 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-acetylneuraminyllactosebinding fibrillar hemagglutinin of Campylobacter pylori: a putative colonization factor antigen. Infect Immun. 1988;56(11):2896-2906.
31. Hirmo 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.laced by 'D'
35. Ruiz-Moyano S, Totten 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;115(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. Glycobiology. 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 IJ, 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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