Technical Bulletin
Human Milk Oligosaccharides (HMO)

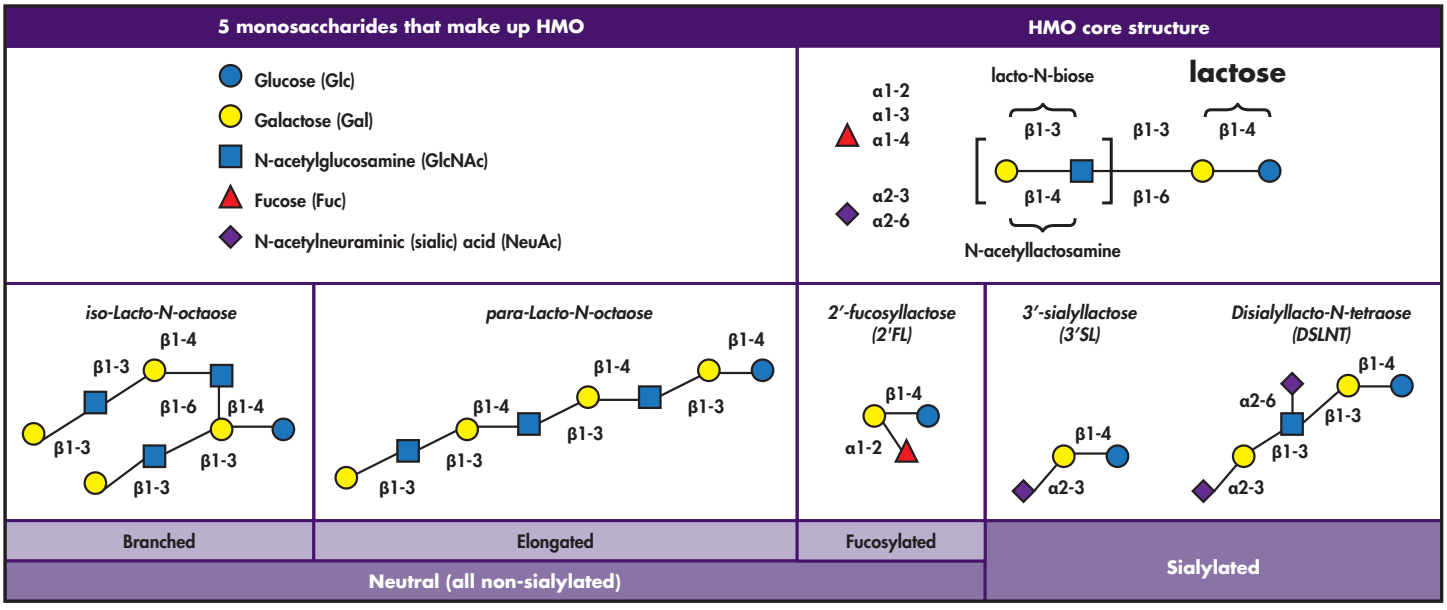
HMO Overview

Human milk contains many diverse and naturally occurring bioactive substances, including human milk oligosaccharides (HMO). HMO were discovered as a prebiotic "bifidus factor" that serves as a metabolic substrate for *Bifidobacterium* spp. and shapes intestinal microbiota composition, with health benefits for the breast-fed neonate.[1] In modulating the microbiome, HMO counteract dysbiosis in the infant's intestine, which leads to the prevention of coinciding diseases.

Approximately 200 different HMO with unique structures have been identified to date.[2] Human milk contains higher amounts and more complex structures of soluble oligosaccharides than any other mammalian milk.[3]

HMO are a family of structurally diverse sugars that are highly abundant in and unique to human milk. They constitute the third-most-abundant component in human milk, following lactose and lipids.[4] HMO are more abundant than protein in human milk.

HMO can be made up of a combination of 5 monosaccharides: glucose (Glc), galactose (Gal), N-acetylglucosamine (GlcNAc), fucose (Fuc), and sialic acid (Sia). For all HMO, the structural backbone is lactose, a disaccharide consisting of glucose and galactose. Lactose can be elongated by the addition of either lacto-N-biose or N-acetyl-lactosamine, which are disaccharide units consisting of Gal and GlcNAc. The monosaccharide fucose or sialic acid can be added to lactose or to the elongated oligosaccharide chain. All HMO containing sialic acid are known as sialylated (acidic) HMO, and all others are known as neutral HMO.



The structural complexity of HMO encountered in human milk, particularly the larger HMO, makes them extremely difficult to synthesize. As human milk is ingested, HMO pass through the stomach and the small intestine unharmed, landing in the large intestine (where a significant percentage of the immune system resides), and they are primarily digested by beneficial bacteria.

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HMO Functions

The great diversity of HMO suggests different biological functions and mechanisms by which they may influence the infant's microbiome and immune maturation and their susceptibility to infections.[4] HMO functions include the following:

- Enhance and sustain growth of beneficial gut bacteria such as Bifidobacteriacae[3]
- Prophylactically bind harmful bacteria, viruses, and toxins to allow for their excretion[3]
- Improve intestinal epithelial barrier function by supporting beneficial bacteria[3]
- Support maturation and regulation of the immune system[5]
- May function as a supplementary source of sialic acid for brain development[6]

HMO in Prolacta Bioscience Products

All Prolacta Bioscience's clinically proven, high-quality neonatal nutritional products are 100% human milk-based and contain a full spectrum of HMO that are critical to support the preterm infant's health and development.[7]

Prolacta Bioscience conducted a study to examine the concentration and variety of HMO present before and after pasteurization. The data are consistent with previous research[8] and demonstrate that HMO are unaffected by pasteurization at temperatures used in most traditional pasteurization methods.

Data from Prolacta Bioscience support the premise that supplementation and fortification of mother's own milk with exclusively human milk-derived products further complements the clinical benefits of exclusive human milk feeding in preterm and other high-risk newborns.[9]

Analyses performed by Prolacta Bioscience[10] and others[8] have shown that there is a full spectrum of HMO found in both Prolact HM® donor milk and Prolact+ H²MF® fortifiers. This is due, at least in part, to Prolacta Bioscience's use of large starting pools, which include hundreds of donors, thus allowing for representation of all the HMO structures.

Table 1: HMO found in Prolact HM donor milk and Prolact+ fortifiers

HMO (neutral)	Pre-pasteurization	Post-pasteurization
3FL	√	√
LNDFH	√	√
2'FL	√	√
LNFP	√	√
LNT	√	√
HMO (acidic)		
6'SL	√	√
LSTc	√	√
3'SL	√	√
LSTb	√	√
DSLNT	√	√

Table 1 is representative of HMO found in Prolact HM donor milk and Prolact+ fortifiers before and after pasteurization; these represent the most abundant HMO in human milk. The choice of HMO measured was dictated by the limited availability of characterized HMO. Inclusion or exclusion of HMO in the list, therefore, does not relate to bioactivity.

Neither parenteral nutrition nor formula naturally contains HMO. There are 1 to 2 synthetic and plant-based oligosaccharides that are added to some preterm and term infant formula products to mimic the role of HMO as prebiotics. Differences in oligosaccharide composition, abundance, and function between human milk and formula remain profound, however.[2]

Many of the benefits in terms of health outcomes for premature infants receiving an exclusive human milk diet can be tied back in part to the anti-infective, anti-inflammatory, and gut maturation activities of HMO.[5]

The source of an HMO has to be human milk. The "HM" in "HMO" stands for Human Milk. Anything else is simply a synthetic oligosaccharide.

References

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