Human Milk Oligosaccharides (HMO)
Mothers Gift for Health across Life Stages

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HMO: Innovación científica que beneficia la salud a la nutrición infantil

The Power of Human Milk Oligosaccharides

Human milk oligosaccharides are beneficial prebiotics that can nourish your baby’s immune system.

Les oligosaccharides du lait maternel

Une avancée nutritionnelle dans les laits infantiles

Parmi les composants du lait maternel impliqués dans la protection immunitaire du nourrisson figurent les HMO ou (Human milk oligosaccharides). Ils constituent le troisième ingrédient clé après le lactose et les lipides et leur utilisation a été approuvée dans les formules infantiles.

Wellness

A Breast Milk Ingredient Is the Hot New Health Supplement for Adults

By Jack Kaskey
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HMOs are the 3rd largest macromolecular component in human milk – main differentiator from bovine milk

Macronutrients in Cow’s milk and Human breast milk (g /Liter)

- **Oligosaccharides**
  - Cow’s milk: 0.05 g
  - Human breast milk: 5-15 g

- **Lactose**
  - Cow’s milk: 48 g
  - Human breast milk: 70 g

- **Proteins**
  - Cow’s milk: 32 g
  - Human breast milk: 8 g

- **Lipids**
  - Cow’s milk: 37 g
  - Human breast milk: 41 g

2'-FL = 2'-Fucosyllactose
HMO – a mixture of > 200 different molecules, of which 2’-FL is the most abundant in most mothers.

HMO are made from common building blocks:
- D-Glucose (Glc)
- D-Galactose (Gal)
- N-Acetylglucosamine (GlcNAC)
- L-Fucose (Fuc)
- N-Acetylneuraminic Acid (Neu5Ac)

Prebiotics GOS and FOS have totally different structure:
- Galactooligosaccharides (GOS)
- Fructooligosaccharides (FOS)
HMOs have prebiotic effects and can directly interact with pathogens and mucosal surfaces.

- **Prebiotic effect**
  - Commensal bacteria
  - HMOs

- **Antimicrobial / antiviral activity**
  - HMOs
  - Virus

- **Mucosal barrier maturation**
  - HMOs
  - SCFA

- **Modulate pathogen recognition**
  - HMOs
  - TLR

- **Effects on inflammation & immune function**
  - HMOs
  - Galectins
  - MLN
  - B cell, Th1, Th2, Th17, Treg

Source: adapted from Ayechu-Muruzabal V et al. (2018)
HMO help building a healthy gut & microbiota during early life, the fundament for health across life-stages.

Development of healthy gut & microbiota

Digestion & Absorption
- Growth
- Development

Gut-Brain-Interaction
- Cognition
- Mood

Immunity
- Protection
- Tolerance
2‘'-Fucosyllactose (2‘'-FL) can contribute to Infant healthy development in various ways

- Promote a healthy microbiota dominated by bifidobacteria and lactobacilli

- May support gut comfort by reducing colonic motor contraction and colics

- Help protect against inflammatory and allergic disease

- Contributes to reducing infections during early life
Level of 2ʻ-FL in breast milk is associated with protection against infectious diarrhea (observational trial)

- Data from 93 breast-feeding mother-infant pairs (prospectively studied from birth to 2 years) were analyzed with respect to 2-linked fucosyl-oligosaccharides in human milk and the occurrence of diarrhea in the infants.

- Moderate to severe diarrhea of all causes was inversely associated with their mother’s milk levels of total 2-linked fucosyl-oligosaccharides (% of total milk oligosaccharides).

- Campylobacter diarrhea occurred less often infants whose mother’s milk contained high levels of 2ʻ-FL.

The study provides evidence suggesting that HMOs are clinically relevant in protection against infant diarrhea.

2’-FL drives the maturation of the infant’s developing immune system

Infants fed 2’-FL fortified formulas with a caloric density similar to human milk (NCT01808105)

Infant formula supplemented with 2’-FL and Lacto-N-neo tetraose (LNnT) (NCT01715246)

Lower plasma and ex vivo inflammatory cytokine profiles, similar to those of breastfed infants in the reference group

Reduced morbidity (particularly bronchitis) and medication usage (antipyretics and antibiotics)

Source: Puccio G et al. (2017); Source: Marriage BJ et al. (2015); Goehring KC et al. (2016)
2’-FL intake is linked to risk of allergy development (Association study)

- Milk samples of 266 mothers of infants with high allergy risk were analyzed.
- Associations between FUT2-dependent HMOs and incidence of allergic disease at 2 and 5 years of age were studied.
- At 2 years of age, a lower incidence for IgE-associated eczema manifestation in C-section born infants who were fed breast milk containing FUT2-dependent oligosaccharides was found.
- When testing levels of 2’-FL as proxy for FUT2 activity, significant associations in the C-section born infants with „any allergic disease“, IgE associated disease and eczema were found.

**Human milk oligosaccharides may have a preventative role in infants with high allergy risk.**

HMO in Infant Milk Formulas: More and more products are available in the market
HMOs have generated a lot of media interest lately
... the interest in the media has turned into first products
Digestive Health
Digestive support accounts for 10% of the dietary supplement market – Europe being the 2nd biggest region

$62 bn

$6.5 bn

The market is very attractive as it has grown by 8% over the last years

Source: Euromonitor, 2018
New product launches have grown by 11%. Specifically, products including prebiotics are on the rise.

- **Format types**
  - Powders and capsules represent more than 50% of newly launched formats.

- **Number of new product launches with digestive positioning**
  - New product launches have a very interesting CAGR of 11%.

- **Number of prebiotic launches**
  - The number of products grew from 2,000 to 7,200 products.

Source: Mintel, 2019
The importance of the gut microbiome is being discovered: Awareness and research are “exploding”
2’-FL is well tolerated in healthy adults and can shape the microbiota

- Prospective, randomized controlled clinical intervention trial including 100 healthy adults between 19 – 57 years
- Test 2’-FL, LNnT and 2’-FL plus LNnT (2:1) at daily doses of 5, 10 and 20 g for 2 weeks
- 2’-FL and LNnT are well tolerated up to 20 g / day either alone or in combination
- 2’-FL and LNnT increased relative abundance of Bifidobacteria

Supplementing the diet with HMO is a valuable strategy to shape the human gut microbiota in adults, specifically promoting the growth of beneficial bifidobacteria.
The molecular structure of 2’-FL is unique and important.
2’-FL – functionalities have been shown in first clinical trials, preclinical studies and in-vitro tests

- **Promoting the growth of beneficial bacteria**
  
  - Eliason E et al 2015, Alliet P et al 2018
  
  - **Specific energy source for beneficial bacteria**
    
    - Yu Z et al 2013, Martinen M et al 2018

- **Inhibiting pathogen adhesion & infection**
  
  - Inhibit campylobacter adhesion to human cells
    
  
  - Inhibit P. aeruginosa adhesion to human respiratory cells
    
    - Weichert S et al 2013
  
  - Prevent attachment of Norovirus to cells
    
    - Koromyslova A et al 2017

- **Quenching inflammation and supporting the immune system**
  
  - Support an intestinal milieu more resilient to inflammatory disease
    
    - Mozoff EA et al 2016
  
  - Inhibit LPS-mediated intestinal inflammation
    
    - Ho YY et al 2016

- **Normalizing gut movements**
  
  - Reduce colon motor contractions -> useful as preventative in gut motility disorders
    
    - Bienensstock J et al 2013
  
  - Potential treatment for acute stress-induced gut dysmotility
    
    - Farhin S et al 2019
HMO – emerging science suggests benefits in various Health indications
2’-Fucosyllactose
Mother’s gift for health across the life stages