2'-FL
HMO
Human Milk Oligosaccharide*

*not from human milk
When I founded Jennewein Biotechnologie GmbH in 2005, my vision was to develop new production processes for complex oligosaccharides.

From the very beginning, we focused on human milk oligosaccharides (HMOs). Although HMOs occur naturally in human milk, economical processes for the large-scale production of food-grade HMOs were not available when we launched the company. We set out to produce these molecules in very large quantities, at a low cost, and to manufacture food-grade quality products for use as functional food ingredients in infant formula.

During the last decade we have become a technology driver and we now partner well-known brands and international companies for the development and production of HMOs for the nutrition industry, as well as medical and scientific applications.

In everything we do, we try to close the gap between human breast milk and infant formula. And we are getting closer year by year.

In 2015, Jennewein Biotechnologie brought its first food-grade HMO (2’-fucosyllactose) to the market and currently we have six other HMOs in the registration process. Towards the end of 2018, we intend to commence the large-scale production of lacto-N-neotetraose. We recently initiated the first clinical trial with a mixture of HMOs emulating the profile found in human milk. As well HMOs, we also provide the simpler sugars L-fucose and sialic acid, which are present in human milk in significant quantities.

Jennewein Biotechnology was the first to develop economical, large-scale production processes for HMOs, long before anyone else thought this was even feasible. I’m sure we can keep up the pace and bring further exciting new products to the market for the benefit of infants and our customers.
Human milk oligosaccharides (HMOs) are complex sugars that are found only in human breast milk. Babies fed on most ordinary infant formulas do not benefit from the unique properties of HMOs, such as prebiotic activity, the ability to reduce risk of infections, and the positive effect on growth and development. In 2015, Jennewein Biotechnologie launched 2'-fucosyllactose (the most abundant HMO) and now offers further HMOs as ingredients for formula milk, bringing the benefits of HMOs to everyone!

What are human milk oligosaccharides?

HMOs are complex sugars that are found only in human breast milk. Babies fed on most ordinary infant formulas do not benefit from the unique properties of HMOs, such as prebiotic activity, the ability to reduce risk of infections, and the positive effect on growth and development.

The benefits of human milk oligosaccharides

HMOs have many clinically-proven benefits, particularly for newborn children. One of the key properties of HMOs is their prebiotic effect, which promotes the formation of a healthy gut microbiome. HMOs cannot be digested by humans, and therefore pass through the stomach intact. Instead, they can be metabolized by certain bacteria, including bifidobacteria, helping to establish healthy populations of these microbes in the gut soon after birth.

The most abundant HMO (2'-fucosyllactose) is particularly good at encouraging the growth of these health-promoting bacteria. But remarkably, the benefits of HMOs do not stop there. Not only do HMOs provide beneficial bacteria with energy, they also deter harmful bacteria and viruses by acting as decoys. Pathogens must attach to the cells lining the gut in order to cause an infection, and these gut cells bristle with different sugars, which the pathogens use as landing sites. Soluble HMOs in the gut mimic the structure of these cell-surface sugars, and pathogens therefore become coated in HMOs and pass through the gut unable to latch on to any cells. This is an extremely important function in newborn babies, who do not yet have a fully developed immune system. Finally, when acidic HMOs are metabolized by gut bacteria they release vicinal acid, a specialized sugar molecule which is necessary for the proper development of the brain and nervous system.

Human milk oligosaccharides have the following key benefits:

1. A prebiotic effect – HMOs nourish beneficial microbes in the microbiome and confer a growth advantage over less beneficial bacteria.
2. A lower risk of chronic diseases – HMOs reduce the risk of allergies, irritable bowel syndrome and obesity, which are associated with an unbalanced microbiome.
3. A lower incidence of infections – HMOs act as decoys to prevent the adhesion of pathogens, thus blocking the process of infection.
4. A boost to early brain development – acidic HMOs stimulate nerve cell development, promoting language skills, memory and normal social and cognitive behavior.
PREBIOTIC EFFECT

Unlike human cells and pathogens, beneficial microorganisms such as bifidobacteria can use HMOs as an energy source to support their growth and activity. These bacteria compete against pathogens and also have a beneficial immunomodulatory effect.

One week after birth, 95% of the bacteria in the gut of breastfed infants are bifidobacteria, which influences the pH of the intestine and thus reduces the growth opportunities for other — possibly harmful — bacteria.

HMOs also have an additional positive effect on the intestinal flora, by binding certain pathogens and preventing them from attaching to cell-surface receptors, thus reducing their ability to colonize the body. The unique potpourri of HMOs in breast milk influences the composition of the intestinal microbiome. This mixture stimulates the growth and activity of desirable intestinal bacteria, while inhibiting the attachment and growth of undesirable bacteria.

IMPROVING MICROBIOME BY PREBIOTIC EFFECT

With Human Milk Oligosaccharides (HMO)

Without Human Milk Oligosaccharides (HMO)

DECOY EFFECT

Breastfeeding reduces the risk of infectious diseases in children by up to 50% and HMOs play a major role in this process.

The mechanism used by HMOs is simple but highly effective: they mimic the oligosaccharides displayed on the surface of human cells. Pathogens recognize these cell-surface receptors and stick to them, giving them the foothold they need to initiate an infection. But if the gut contains HMOs, the pathogens stick to these soluble molecules instead.

More than 70% of human pathogens must bind to oligosaccharide structures on the cell surface in order for an infection to be successful. Certain HMOs are identical to these cell-surface receptors and can therefore act as decoys. The Pathogens bind to HMOs and cannot stick to any cells. Infants are at greatest risk of infection when feeding, and HMOs are delivered at exactly the right time to ensure that pathogens pass harmlessly through the gut.

REDDUCING INFECTION RISK

With Human Milk Oligosaccharides (HMO)

Without Human Milk Oligosaccharides (HMO)
WHAT ARE HUMAN MILK OLIGOSACCHARIDES?

Human breast milk contains many different sugars – not only simple sugars such as lactose, which are used primarily as a source of energy, but also more structurally complex and diverse HMOs with specialized biological functions.

Human milk contains an unusually high concentration of these complex sugars, a majority of them are not produced by other mammals, including dairy animals. The most abundant HMO is known as 2’-fucosyllactose, which is produced by about 80% of human mothers at concentrations of up to 5 grams per liter.

Other abundant HMOs include 3-fucosyllactose, Lacto-N-tetraose, Lacto-N-fucopentaose and the acidic HMOs 3’-sialyllactose and 6’-sialyllactose.

THE JENNEWEN PRODUCT PORTFOLIO

Jennewein Biotechnology GmbH, founded in 2005 by Stefan Jennewein, is a company driven by science-based research. Jennewein is the pioneer and inventor of a special fermentation process for the production of human-identical HMOs on an industrial scale. Within a decade we have become a driver in scientific research on HMOs and provide infant formula manufacturers the opportunity to add these HMOs to the nutrition of infants. This major breakthrough closes the gap between infant formula milk and human mother’s milk. Now, non-breastfed babies have the opportunity to profit from the beneficial effects of HMOs.

Sialic acid

The presence of sialylated HMOs in human milk is one potential explanation for the better early neurodevelopment of breastfed infants. Premature babies, nourished through their first months of life with mother’s milk show significantly higher developmental scores and better verbal skills at 7-8 years of age.

Sialic acid is an important building block for brain gangliosides, which are complex molecules displayed on the surface of neurons with a key role in brain development.

L-fucose

L-fucose is a rare, naturally occurring monosaccharide. When applied to skin cells, it has a variety of stimulatory effects with a positive impact on skin health.
HUMAN MILK OLIGOSACCHARIDES AND BEYOND

This information is intended for industrial customers only. Potential consumer benefits are not to be considered as health claims. They should be considered as potential leads that might be developed into health claims complying with the local legal requirements.